VOLUME VI MARCH, 1923 NUMBER 2

JOURNAL OF DAIRY SCIENCE

OFFICIAL ORGAN OF THE
AMERICAN DAIRY SCIENCE ASSOCIATION

Contents

Dairying in Vermont in the '70's and '80's—J. L. HILLS. 87
The Alcohol Test as a Means of Detecting Abnormal Milk—A. C. WEIMAR 95
Studies in Milk Secretion. X. Relation Between the Milk Yield of one Lactation and the Milk Yield of a Subsequent Lactation in Guernsey Advanced Registry Cattle—JOHN W. GOWEN 102
Acidity of Butter and its By-Products—F. W. BOUSKA. 122
A Ropy Milk Organism Isolated from the Finnish "Piima" or "Fiili"—HAROLD MACY 127
V. Sodium Hypochlorite. Some Studies on the Bactericidal Action of Sodium Hypochlorite in Cow's Milk—HARPER F. ZOLLER AND SYLVIA M. EATON. 131
Thionin—H. J. CONN 135
The Colostrum Problem and its Solution—ARTHUR C. RAGSDALE AND SAMUEL BRODY 137
A Study of Determining Solids-Not-Fat in Cow's Milk—BENJAMIN MASUROVSKY 145
Noteworthy Events in the World's Dairy Industry, 1922—T. R. PIRTLE 150
Review of Foreign Dairy Literature—R. C. FISHER .. 154

PUBLISHED BI-MONTHLY
WILLIAMS & WILKINS COMPANY
BALTIMORE, U. S. A.

Made in United States of America

This MARK OF SUPERIORITY will be found on all equipment for the

CITY MILK PLANT
ICE CREAM PLANT
and the CREAMERY

that is manufactured by

J. G. CHERRY COMPANY

These well known Dairies are using Cherry Pasteurizing equipment—all or in part:

GEO. M. OYSTER CO., Washington, D. C.
CARRY MFG. CO., Washington, D. C.
FARMERS DAIRY CO., Toronto, Canada
EDMONTON CITY DAIRY, Edmonton, Canada
POLK SANT. MILK CO., Indianapolis, Ind.
UNION DAIRY CO., St. Louis, Mo.

You will be interested in the particulars of the Cherry Method of Pasteurization. Ask us!

J.G.CHERRY COMPANY

ST. PAUL MINN. — TAMA IOWA — PEORIA, ILL.
CEDAR RAPIDS
IOWA

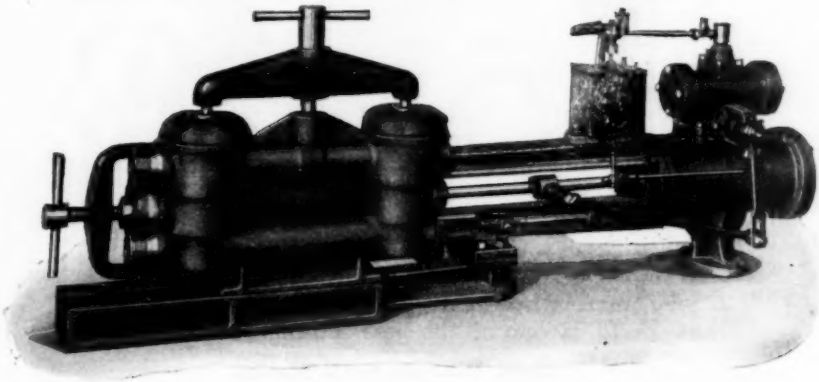
Entered as second-class matter June 9, 1917, at the Postoffice at Baltimore, Md., under the Act of March 3, 1879
Acceptance for mailing at special rate of postage provided for in Section 1103,
Act of October 3, 1917, authorized on July 18, 1918

Copyright 1922 by Williams & Wilkins Company

"DAVIDSON"

MILK PUMP

50,000 LBS. PER HOUR



MILK PUMPS

BOILER FEED PUMPS BRINE-CIRCULATING PUMPS
TANK SUPPLY PUMPS WASHER PUMPS
ARTESIAN WELL PUMPS

Send for Latest Catalog

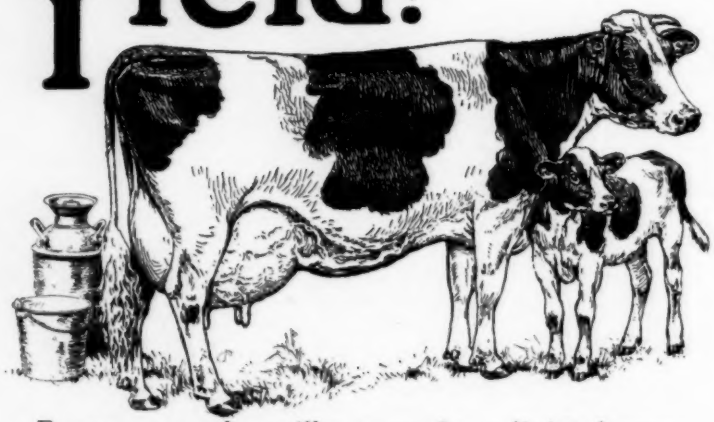
M. T. DAVIDSON COMPANY

154 Nassau Street, New York

135 Oliver St., Boston, Mass.
617 Cherry St., Philadelphia, Pa.
1224 Granite Building, Rochester, N. Y.
604 Empire Building, Detroit, Mich.
817 Albee Building, Washington, D. C.
609 Wade Building, Cleveland, Ohio

Your advertisement is being read in every State and in 25 Foreign Countries

Yield!



Every man who milks cows for a living knows that *Yield* is one of the best reasons for Holsteins.

Yield To You Will Mean:

Dependable Cash Income - Profits - Bank Account
Independence - Better Things for the Family

Holsteins hold all world's records and average highest over all breeds for butterfat and milk yield.

Let Us Tell You the Story of the Holstein Cow

EXTENSION SERVICE
The Holstein-Friesian Association of America
230 East Ohio Street, Chicago, Ill.

HOLSTEINS

Your advertisement is being read in every State and in 25 Foreign Countries

JOURNAL OF DAIRY SCIENCE

OFFICIAL ORGAN OF THE
AMERICAN DAIRY SCIENCE ASSOCIATION

J. H. FRANDSEN, Editor
Lincoln, Nebraska

ASSOCIATE EDITORS

F. W. BOUSKA, Chicago, Ill.
A. A. BORLAND, State College, Pa.
C. H. ECKLES, St. Paul, Minn.
R. C. FISHER, Storrs, Conn.
J. B. FITCH, Manhattan, Kans.
J. A. GAMBLE, College Park, Md.
E. S. GUTHRIE, Ithaca, N. Y.
H. A. HARDING, Detroit, Mich.
S. H. HARVEY, College Park, Md.
O. F. HUNZIKER, Chicago, Ill.
H. H. KILDEE, Ames, Iowa
C. W. LARSON, Washington, D. C.
W. B. P. LOCKWOOD, Amherst, Mass.
M. MORTENSEN, Ames, Iowa
LEROY S. PALMER, St. Paul, Minn.
T. R. PIRTLE, Washington, D. C.
C. L. ROADHOUSE, Davis, Calif.
L. A. ROGERS, Washington, D. C.
H. A. RUEHE, Urbana, Ill.
W. A. STOCKING, JR., Ithaca, N. Y.
H. E. VAN NORMAN, Washington, D. C.
IVAN C. WELD, Washington, D. C.
G. C. WHITE, Storrs, Conn.

OFFICERS OF AMERICAN DAIRY SCIENCE ASSOCIATION

President ..... A. A. BORLAND, State College, Pennsylvania
Vice President ..... O. E. REED, East Lansing, Michigan
Secretary-Treasurer ..... J. B. FITCH, Manhattan, Kansas

SECTION NO. 1—DAIRY PRODUCTION

Chairman ..... O. E. REED, East Lansing, Michigan
Secretary ..... A. B. RAYBURN, St. Paul, Minnesota

SECTION NO. 2—DAIRY MANUFACTURES

Chairman ..... H. A. RUEHE, Urbana, Illinois
Secretary ..... J. R. KIETHLEY, St. Paul, Minnesota

SECTION NO. 3—DAIRY EXTENSION

Chairman ..... E. M. HARMON, Columbia, Missouri
Secretary ..... A. J. CRAMER, Madison, Wisconsin

SECTION NO. 4—OFFICIAL TESTING

Chairman ..... ROY T. HARRIS, Madison, Wisconsin
Secretary ..... G. C. WHITE, Storrs, Connecticut

Your advertisement is being read in every State and in 25 Foreign Countries

BABCOCK TESTERS

See Jour. Dairy Sci., Jan. 21, 1921, page 32

INTERNATIONAL EQUIPMENT COMPANY

352 Western Ave. (Brighton)

BOSTON. MASS.

YOUR ADVERTISEMENT WILL BE READ

By dairymen, creamerymen, county agents, commercial firms, dairy husbandry departments of colleges, progressive farmers and breeders, ice cream manufacturers, milk chemists and bacteriologists throughout the United States

WHEN IT APPEARS IN

THE JOURNAL OF DAIRY SCIENCE

For information
Apply to

THE JOURNAL OF DAIRY SCIENCE
Mt. Royal and Guilford Aves.
Baltimore, Maryland

Chr. Hansen's RENNET EXTRACT

is of the highest strength and is pure, because it is made only from the finest rennets. Always uniform and dependable. Backed by 44 years of scientific manufacture.

Hansen's CHEESE COLOR

is a pure vegetable annatto color of the *right shade.* Always colors uniformly, and is of the highest strength. Use Hansen's Cheese Color with Hansen's Rennet Extract to make every day's output of the highest quality.

Chr. Hansen's Laboratory, Inc., Little Falls N. Y.
Western Branch—Milwaukee, Wis.

MARSCHALL RENNET AND COLOR

STRONG PURE

DEPENDABLE

Made in the largest and best equipped Rennet factory in America!

THE MARSCHALL DAIRY LABORATORY
MADISON WISCONSIN

THE DAIRY LABORATORIES

20th and Market Streets, Philadelphia, Penna.

CONSULTING AND ANALYTICAL CHEMISTS

Complete Chemical and Bacteriological Analysis of Milk, Ice Cream, Dairy Products, Food, and Water

Manufacturers of

"Special colored Corrosive Sublimate Tablets for preserving Composite samples in Babcock fat Testing"
"Chlorine Solution to sterilize milk utensils"
"Sour milk Testing Solution for detecting sour milk rapidly"
"Cultures for ripening milk in making buttermilk, butter, sour cream, etc."
"FLY Spray to keep flies off dairy cattle"

Sanitary Advice and Expert Assistance
All Tests Confidential

DR. LEE H. P. MAYNARD, Milk Expert
H. C. CAMPBELL, B.S., M.D., PH.G. Chemist
DR. H. S. JOHNSON, Bacteriologist RALPH FORT, Assistant

Branches at
WASHINGTON, D. C. PITTSBURGH, PA.
BALTIMORE, MD. ST. LOUIS, MO.

Your advertisement is being read in every State and in 25 Foreign Countries

Your Trouble Eliminated At Last

As the result of many years persistent experimenting we are now in a position to offer to the Creamery Trade

Wagner's Precision Test Bottles

WITH PERMANENT BLACK ETCHED GRADUATION

which we guarantee to withstand acids or the strongest alkali solution commonly used in cleaning test bottles.

We guarantee this graduation never to decolorize. It enables you to read your test correctly at all times; saves your eyesight; you need not be troubled any longer with disappearing invisible graduations, a most important feature which is highly appreciated by all users. Some of the testimonials received, read:

"Your Test Bottles With Permanent Black Etched Graduation Are Worth Their Weight in Gold."

Owing to the unusually strong demand, our manufacturing resources are already taxed to the limit. We, therefore, ask you to place your orders in time.

Ask for our illustrated catalog for testing milk and its products.

ESTABLISHED 1887

Awards

Panama International Exposition

Louisiana Purchase Exposition

THE WAGNER GLASS WORKS, 695-697 E. 132nd St., New York, N.Y., U.S.A.

Inventors and Manufacturers of Scientific Glassware and Apparatus for Testing Milk and its Products

Your advertisement is being read in every State and in 25 Foreign Countries

Shaw Separatory Funnel

SHAW TEST

FOR

Determining Fat in Butter

BASED UPON CORRECT SCIENTIFIC PRINCIPLES

A simple, economical test for practical creamerymen.

The fat is weighed instead of measured, thus eliminating errors introduced by the effect of variations in temperature and specific gravity of fat, an important feature in the case of a substance as high in fat content as butter.

Requires little extra time or equipment than that needed for Babcock and moisture tests.

Bulletin of Directions sent with Separatory Funnels or upon request.

NAFIS SALT TEST

can be used in connection with the Shaw Test with but few extra steps. It is

Accurate—Economical—Simple

Nafis Salt Test

Our INDICATOR and STANDARD SOLUTION are put up in convenient form and can be sent by parcel post for a few cents.

Our Concentrated Standard Solution is prepared in our laboratory with the same degree of accuracy that characterizes NAFIS GLASSWARE.

The small bottle is sufficient to make one thousand c.c. of solution, thus avoiding transportation charges on large bottles and water.

If you are not already using NAFIS GLASSWARE write for our catalog and the names of our distributors in your territory.

Louis F. Nafis, Inc.

Manufacturers of Scientific Glass Apparatus for Testing Milk and its Products

542-548 Washington Blvd., Chicago, Ills.

ASK THE MEN WHO USE IT

Your advertisement is being read in every State and in 25 Foreign Countries

JOURNAL
of
DAIRY SCIENCE

CONTENTS OF 1922 ISSUES

A Study of the Chemical and Physical Properties of Remade Milk. L. S. Palmer and C. D. Dahle.

The Determination of Yeasts and Oidia in Cream and Butter. W. Redfield

The Stage of Lactation as a Factor in the Variation of the Per Cent of Fat in Cow's Milk. Arthur Ragsdale and Charles W. Turner.

Coconut Meal, Gluten Feed, Peanut Meal and Soybean Meal as Protein Supplements for Dairy Cows. Andrew C. McCandlish and Earl Weaver.

Fat Analysis of Milk Powder. G. C. Supplee and B. Bellis

Is Lipase a Normal Constituent of Cow's Milk? Leroy S. Palmer.

Proof of the Presence of Lipase in Milk and a New Method for the Detection of the Enzyme. Frank E. Mice and Alton L. Markley.

Studies in the Control of a Municipal Milk Supply. Ira Vaughan Hiscock.

A Color Test for "Remade" Milk and Cream. Oscar L. Evenson.

Methods of Caring for Milking Machine Tubes. Robert S. Breed.

Outlines for a Study of Milk Production Costs. John A. Hopkins, Jr.

Bitter Milk of Advanced Lactation—A Lipase Fermentation. L. S. Palmer.

The Effect of Temperature on the Percentage of Fat in Milk. Arthur C. Ragsdale and Samuel Brody.

Bacterial Content of Milk Powder. G. C. Supplee and V. J. Ashbaugh.

The Improvement of Quality in Milk Through the Efforts of College Extension Service. James D. Brew.

The Structure of Powdered Milk and Its Possible Relation to the Keeping Quality of Whole Milk Powders. L. S. Palmer and C. D. Dahle.

The Identification of the Bovine by Means of Nose Prints. W. E. Peterson.

Is a Preliminary Dry Milking Essential in Semi-Official Tests? J. B. Fith, R. B. Becker and P. C. McGilliard.

The Condensation Process of Preparing an Ice Cream Mix. R. W. Peterson and P. H. Tracy.

Effect of Steaming upon the Germ Life of Milk Cans. H. A. Harding.

New Method of Balancing Rations. B. I. Masurovsky.

Studies in the Growth and Nutrition of Dairy Calves. A. C. McCandlish

A Comparison of Early, Medium, and Late Varieties of Silage Corn for Milk Production. G. C. White, et al.

Studies in the Growth and Nutrition of Dairy Calves. A. C. McCandlish.

Yeast and Mold Counts and Their Relation to Pasteurization. B. A. Stiritz.

Laboratory Supervision of Pasteurization Plants. Ira Vaughan Hiscock.

A Note on the Weinzirl Anaerobic Spore Test for Determining Manurial Pollution of Milk. James R. Hudson and Fred W. Tanner.

The Relationship between the Hydrogen Ion Concentration and the Bacterial Content of Commercial Milk. Edwin W. Schultz, Alberta Marx and Harold J. Beaver.

The Physical Analysis of Dry Milk. R. M. Washburn.

A Method for the Determination of Amino Nitrogen and Ammonia in Cream and Butter. L. W. Ferris.

The Danger of Improperly Capped Milk Bottles. J. G. Jackley.

The Milking Machine an Important Factor in Milk Quality. J. D. Brew.

The Causes of Leaky Butter. A. C. Dahlberg.

Influence of Certain Factors on the Methylene Blue Reduction Test for Determining the Number of Bacteria in Milk. E. G. Hastings, Audrey Davenport, and W. H. Wright.

The Copper Content of Cow's Milk. G. C. Supplee and B. Bellis.

Methods of Measuring the Volume of Cream on Milk. H. A. Harding, F. W. Kelly and E. S. Chrisler.

A Weight-Height-Age Curve as a Measure of the State of Nutrition and of Growth of the Dairy Cow. Samuel Brody and Arthur C. Ragsdale.

Actinomyces in Milk with Special Reference to the Production of Undesirable Odors and Flavors. Carl R. Fellers.

The Care of Morning Milk before Pasteurization. Harold Macy.

Loss in the Grain of Corn in Storage as Silage. W. L. Gaines.

Review of Foreign Dairy Literature.

The Heat Coagulation of Milk. H. H. Sommer and E. B. Hart.

Seasonal Variations of the Per Cent of Fat in Cow's Milk. Arthur C. Ragsdale and Charles W. Turner.

A Method for the Quantitative Determination of Gelatine in Ice Creams. L. W. Ferris.

A Metabolism Crate for Calves and Other Small Ruminants. A. C. McCandlish and Fordyce Ely.

Bacteria Counts of Milk Powder as Obtained by the Microscopic Method. G. C. Supplee and V. J. Ashbaugh.

Review of Foreign Literature. S. H. Harvey.

Your advertisement is being read in every State and in 25 Foreign Countries

Hypochlorite Sterilizing Recognized By Metropolitan Health Boards

The present tendency of metropolitan health boards is to sanction hypochlorite sterilizing in answer to the demand of milk bottlers, ice cream manufacturers, et al.

Ordinances in our largest cities and laws in our states where milk distribution is a major factor, are recognizing chemical sterilization as the cheapest means to the end of laying pasteurized milk down in the cities with a uniform count of 10,000 to 15,000 bacteria per c.c.

Milk bottles can be so sterilized to such a degree that laboratory plates regularly show counts of 60, 40, and 0 bacteria per bottle.

In addition to giving the greatest degree of sterilization possible under practical conditions—the method is decidedly economical as it provides a considerable saving of coal. The price of one ton of steam coal will pay for enough B-K to do double the same amount of sterilizing. In addition, the bottles will be cool enough to fill promptly without the labor of stacking. This means a labor saving of two to three dollars per day.

Some cities have gone a step further and have advocated chemical sterilization at the source of supply, i.e., the farm.

General Laboratories has advocated this for years. A plan has been worked out by us which will produce a count of less than 25,000 in farmer's milk in the can when it reaches the city.

One of the largest and most progressive cities in America is using our plan with decided and definite success.

Write for Bulletin 320-A, which explains the B-K plan.

General Laboratories

Madison, Wisconsin

Your advertisement is being read in every State and in 25 Foreign Countries

DAIRYING IN VERMONT IN THE 70's AND 80's

J. L. HILLS

College of Agriculture, University of Vermont, Burlington, Vermont

Received for publication November, 1922

It is not known, so far as the writer is aware, when cows first came into Vermont. Apparently they entered New England in 1624 at Plymouth, Mass. The State was first permanently settled from the south in 1755. Probably the hardy pioneers who came up the Connecticut Valley brought cows with them. How good they were can not be told, for in the old town records of Hadley, Mass., 30 miles south of the site of Vermont's first permanent settlement, it is stated that the cows gave so little milk, particularly during the winter, that some of the babies had to be brought up on cider. Thanks to the late Governor Hoard and to the present Mr. Volstead "it never can happen again."

The Vermont state seal pictures a cow. It is the only state seal which in any way recognizes the dairy industry. Plows appear on thirteen state seals; sheaves of wheat on nine; sober Connecticut, the land of steady habits, displays upon its seal three grapevines; Utah, a busy beehive; and Tennessee blazons the word "Agriculture" across the middle of its seal. On Vermont's seal only, however, is portrayed the likeness of the cow. She is rather blocky in form, for the wedge shape had not been thought of when she took her stand underneath the pine tree, but there she is. Tradition has it that during the Revolutionary War a British officer held in captivity near Burlington, etched on a horn the outline of Mounts Mansfield and Camel's Hump, as seen from an outlook on the farm belonging to Ethan Allen of Ticonderoga fame, now a public park. He is said to have included in his picture a large pine tree and an old cow, both of them in the foreground at the time when he was at work. Tradition further declares that the state seal was made in the 1790's from this crude etching. However, regardless of the way in

which bossy wandered into the picture, certainly it is meet and right that she should have done so; for throughout the censuses from 1790 to date, Vermont has led every state in the Union in respect to her cow population per unit of improved land.

The writer has been unable to find anything authentic as to the status of dairy husbandry in Vermont during the last half of the eighteenth and the first two-thirds of the nineteenth century. There were cows in plenty and butter and cheese were made and sold from private dairies. There is ample testimony, however, as to the situation from the early seventy's onwards.

Vermont dairymen first fore-gathered in the fall of 1869 and formed the first Dairymen's Association in the country. Some twelve years ago, the Hon. Homer W. Vail of Randolph—long-time breeder of registered Jersey cattle, one time member of the executive committee of the American Jersey Cattle Club, still living, far along in years and personally in touch with Vermont dairying for sixty years—addressed the Vermont Dairymen's Association concerning early dairying in Vermont. He said, touching the conditions when the first meeting was held in the winter of '69–'70, that

> The old native cow reigned supreme. Very few herds of purebred cattle and practically few grades of the milking breeds were to be found in the State. Nobody had learned the value of early cut hay or the superior worth of clover. The only grain fed was cornmeal with sometimes oat mixture. No cottonseed meal, gluten meal or oil meal were used and bran was frequently run into the stream as a refuse, as is sawdust at lumber mills today. There was no general knowledge as to balanced rations for domestic animals. Had any scientist then ventured to talk to the Vermont farmers concerning microbes, protein or carbohydrates, he would have been thought impractical if not insane.
>
> Butter was made from cream skimmed from milk set in small 10-quart pans. There were no creameries and I have been unable to find notice of cheese factories at that period in Vermont.[1] There was no such thing as the deep setting of milk; no use was made of large pans;

[1] As a matter of fact, C. S. Baldwell established a cheese factory in West Pawlet, Vt., on the New York state line which continued in operation until 1921; and there may have been others.

there were no separators; there was no manufacture of dairy goods in a large way. There were no veterinary surgeons to advise concerning animal diseases, and very little general knowledge as to their cause, nature, symptoms or remedies. There were some cow doctors who, like poets, were "born not made," and "horn-ail" was the popular bovine malady.

At its initial meeting in 1870, Mr. X. A. Willard, of Herkimer County, New York, the dairy editor of the Rural New Yorker, perhaps the outstanding dairy authority of the day in the East, addressed the audience. From the statements that he made may be culled the following: That "fat globules were enveloped in their shells of curd or casein;" that "milk of an average good quality (contains) 3.43 per cent butter;" that "milk varies in character from various causes, but chiefly in the butter and milk sugar, the casein showing but slight variation;" that "milk of the best quality and cheese of the best flavor comes only from good upland pastures" regardless of "what the theorists may say;" that odors in the air tainted milk "even before it was drawn;" that "small particles of milk in the corners of pails or open utensils when exposed to the air rapidly decompose and . . . . reproduce themselves;" that "when curds are exposed to the atmosphere the external parts become rapidly oxidized;" that "oats are considered to increase the quantity, barley the richness of the milk;" that "the Orange County buttermakers find (no churn) which they like so well as the old barrel dash churn;" (Orange County, New York was the acme of butter making regions in those days).

At this 1870 meeting, statements were made by some of the best informed dairymen of the day, to the effect that "not over 1 per cent of the market butter of this country is strictly prime" and that "the average price is not over one-third of that of the first quality goods;" that "in many large establishments the ancient ladle and bowl are still the only implements used for working butter;" that "the processes pursued by practical dairymen are not sufficient to secure perfect separation of the butyraceous particles;" and that "salt is used to aid in that separation and to preserve the casein or curd left in minute

particles in the butter." The same speaker cited the fat content "of good milk from the milkman's can" at "2.88 fat."

He indicated that "heavy return pails well painted on the outside" were largely used for the packing of Orange County butter, the best New York market butter then made. Pails, firkins and tubs were commonly employed. The small box or package was "not commended" on the ground that "it only answers the same purpose as a sheet of brown paper . . . . useful for families who get their supply weekly and do not care to receive it in form for the table." "A thick, solid return pail of a size adapted to a family's wants for a month is better for both producer and consumer." Prints were uncommon but pound balls "wrapped in a plain linen napkin (carrying) the name of the maker and number of the stall where sold" were sold "the producer, when he comes for the next ball, returning the napkin, neatly ironed and folded ready for use again." It is interesting to note that "the system of marketing which prevails in the neighborhood of New York City is for the producer to send his products once or twice a week to market by a man called a captain, from the fact that formerly this service was all performed by captains of North River barges." The Vermont markets were largely local. Shortly before the Civil War, the Central Vermont Railroad began to run a refrigerator car once a week to Boston. The markets were unorganized, there was no collusion among buyers, no system of reports. In those days, the Little Falls and Utica, New York markets were large affairs.

The pictures of cattle published in the dairy books, pamphlets, etc., were interesting. Of five pictures of Ayrshires and Shorthorns published in this early report, one shows slightly the wedge shape, three are as nearly rectangular as may be, and one shows a reverse wedge shape.

The Secretary of the Massachusetts State Board of Agriculture —himself a university trained man and a farmer, the father of my first college room-mate—in 1871 told the Vermont dairymen that "the Boston milk supply is a disgrace to civilization;" that "there is a row on between producers and contractors, the latter being too strong for the former;" and that "all the milk is

produced within 40 to 50 miles of Boston." In those days, milk was sold raw, more or less—and probably more—dirty, with little or no inspection. Adulteration was common, dipped milk universal, and the cream trade unknown. The butter then sold was almost all dairy butter. There were no separators or deep setting devices. It was made from shallow settings, skimmed more or less completely, the cream irregularly ripened, the butter more or less mottled and sold in large packages, with quality variable and prices fluctuating, but low. There was but little winter dairying. Butter was "put down" for the winter.

In the early seventies, ice cream was almost unknown. The writer was brought up, as a child, in Boston. The only ice cream he ever knew, in the early seventies, was sold by "Billy Nichols," a peripatetic vender, who rambled about the streets ringing a bell. As a boy, he remembers freezing a small quantity of ice cream in a tinpail which he painfully twisted back and forth for an hour or more in a bucket of broken ice. Family size ice cream freezers were almost unknown. There was no such thing as an ice cream parlor. Ice cream was not purveyed at drug stores or candy stores; indeed, there were almost no candy stores then. If one had ice cream half a dozen times during the summer in small quantities, he was doing remarkably well. It was never used as a dessert.

The writer came to the University of Vermont and the Vermont Station in 1888. He promptly took up work in connection with the study of dairy manufactures. Butter was then made from milk set in a shallow pan, or in the so-called "Orange County pan," a rectangular device, or in the so-called "Ferguson Bureau" creamery, wherein pans were assembled in bureau style, or in the deep setting cylindrical cans surrounded by water, the so-called Cooley or Stoddard cans. Factory separators were just beginning to come in, the first two in the State being owned by the late F. L. Evarts, of Vergennes, and by E. J. Parker of Grand Isle, now living, about eighty years of age, the only living charter member of the fifty-two year old Dairymen's Association, the only man who has attended 51 meetings. There were no farm

separators. The factory separators were mostly of the so-called Danish-Weston type. These were built upon the general lines of the modern centrifugal washing machine. They were wide open—one could throw a cat in when the thing was running and the mechanism would probably skin the cat and deliver the skin from one spout and the body from the other. There were very few creameries and these dealt mostly with the product of the deep setting cans.

There was no Babcock test. Payments were made according to many systems. There was the flat payment system, all too commonly in vogue. There was the "space" system, whereby the volume of cream was read against a glass gauge set into a cylindrical can. All spaces looked alike and were held to be alike, although actually highly unlike in their butter fat contents. There was the "gang churn" system, whereby small samples of creams from Smith's, Jones' and Brown's dairies were separately churned in the same churn, made up of a number of compartments, payments being based upon the weight of the butter churned from each sample. There was the "oil test churn," where small quantities of cream from the various dairies were churned in test tubes, the butter melted and the volume of the melted fat determined.

Under such circumstances, there was necessarily much inaccurate work done and farmers were sorely tempted to extend their milk. The writer visited many Vermont creameries and communities in the pre-Babcockian days, took samples, brought them to the station laboratory and tested them; and in the early days of the Babcock test he did the same thing. Some of his findings were interesting. In one community, 39 out of 40 samples of milk showed either watering, skimming or both. One sample was so thin that 115 pounds of milk were needed to make a pound of butter. The plea of the farmer was that he only had two or three cows, that the day before had been Thanksgiving and that his wife wanted the cream for dinner. At another location, a very thin milk was found, whose seller claimed that what he did was justifiable in that there had been a strawberry festival at the church the night before and he had

given the cream to the Lord. The writer once found a fish in the sample dipper at creamery on the shores of Lake Champlain. Angle worms were frequent inhabitants of milk. In one case the farmer's pump was found to be full of angle worms. His alibi was that he had held the milk uncovered under an apple tree during the night and that undoubtedly the worms had crawled up the tree trunk, out on the branches and had dropped into the milk. In another case, the presence of an uncrated Babcock tester in the creamery served immediately to drop the number of pounds per pound of butter from 27 to 22 pounds. Almost invariably, when the writer stayed two days at a creamery most of the milks were of better quality on the second day than they were on the first.

There was much to be said on the side of the dairy farmer of the eighties and nineties. When milk is paid for on a flat basis, regardless of quality, the dairyman who is making a relatively rich milk is greatly tempted to extend it. It is an open question whether, as a matter of fact, the introduction of the Babcock test into many communities did not conduce quite as much to the spread of morality as did the expoundings from some country pulpits.

The first, or nearly the first, hand separator in Vermont was placed on the University farm in 1888. It was hand run—there was no such thing as motors in those days—and skimmed 300 pounds to the hour.

Throughout the nineties the Babcock test was greatly misunderstood and distrusted. It was reviled as being inaccurate and the operators were said to be careless or worse. All kinds of legislation was proposed with a view to remedying the situation, which of course long ago has thoroughly settled down. As a result of this agitation and the obvious necessities of the case, glassware and machines are periodically inspected, operators are examined and licensed and there is a provision whereby any aggrieved patron, believing that the tests are faulty, may call for help from the Commissioner of Agriculture, who is empowered to enter upon the premises, to take charge of and to test all samples at a given creamery where there is reason to believe that inaccurate work is being done.

In 1877, at the eighth meeting of the Vermont Dairymen's Association, Mr. Willard, who was quoted early in this article, set forth "the history of American dairying." His statements had to do mainly with cheese. In the course of his remarks, he contrasted "the flood of light which now illumines the path of the dairyman with the meagre knowledge which he possessed twenty years ago." It may be justly claimed that in the forty-five years which have elapsed since Mr. Willard made this statement, the illumination has considerably increased in brilliancy. One can only conjecture how extensively our children of 1970 will be "lit up."

THE ALCOHOL TEST AS A MEANS OF DETECTING ABNORMAL MILK

A. C. WEIMAR

Dairy Division, United States Department of Agriculture, Washington, D. C.

Received for publication November 1, 1922

In the methods of determining the quality of milk, the alcohol test has not yet found a very important place. Many investigators have found this test to be of great value, but in a practical way, have not been able to agree on its merits for use in the milk-receiving room. Other quality tests are employed, but the one most universally used is the acid test, even though its defects have become generally recognized. It is well known that the present acid test does not indicate the true acidity, since the casein and salts combine with the alkali, which, at times, results in an apparent high acidity in fresh milk. Under any conditions dairy manufacturing plants, and especially condenseries, would welcome any rapid and accurate test that would determine the quality of milk received. It is the object of this paper to throw more light, if possible, on work already done on the alcohol test, that it may, in some way, hasten the perfection of a reliable test.

Unfortunately, scientific investigators who have studied the alcohol test have drawn varying conclusions and disagree widely as to its value. Of those who have worked with it, Morres (1) is probably the most ardent supporter. He and other advocates claim it to be of great value, since it offers a quick and simple means of determining the condition and keeping quality of milk. We, are inclined to believe, with Campbell (2), Ernst (3), and Auzinger (4), that the alcohol test is of value, in that a positive reaction may be indicative of a chemical change in the milk. We base our belief on the studies of several cases of abnormal milk which were brought to the attention of this laboratory.

Before going into the details of these cases, it may be well to state that we have no definite conclusions to offer, other than those presented by the observations made, and we do not wish to convey the opinion that silage should not be fed to cows delivering milk to condenseries. We are, however, of the opinion that, in certain cases, physiological conditions may be found in the cow which will result in the production of abnormal milk, with a dangerous effect on the sterilization of evaporated milk. Hunziker (5) states that there are still some condenseries that will not accept milk from silage-fed cows, and it may be that the following cases are examples of difficulties which caused these condenseries to make a rejection rule of this kind.

EXPERIMENTAL TESTS WITH MILK

During April, 1921, while running alcohol tests on all the milk received at the creamery in Grove City, Pa., two cases of positive-reacting milk were found. The first of these was brought to our attention after the patron's milk had been rejected for a week. We immediately ran some preliminary tests on the milk, having received individual samples from each cow of the herd. Table 1 shows the results.

It can readily be seen from Table 1 that no ordinary test would lead us to distinguish those milks which reacted positively from those that reacted negatively. The acidity of each sample was normal, and the bacterial counts do not indicate an unusual disturbance.

The following afternoon a visit to the farm proved that the silo had been emptied that morning. Upon examining the silage, it was found moldy and partly decomposed. Then the above tests were shown to the patron, he stated that some of the cows had refused the silage, and later, further investigation proved that the cows reacting positively to the test were the same cows that had eaten plentifully of the silage, while those reacting negatively had refused it. A few days after discontinuing the feeding of silage, this patron's milk was again accepted as normal.

At the same time these first tests were being run, a similar case was brought to our attention where the herd milk reacted

positively to the alcohol test. Table 2 shows the results of the preliminary tests:

Again we found nothing that would give us a clue to the cause of the variation of positive and negative results, but the experience

TABLE 1

Milk from first herd fed moldy silage

NUMBER OF COW	FERMENTATION TEST	ALCOHOL TEST	BACTERIA COUNT	ACID TEST	FLAVOR AND ODOR
1	Very gassy	+	100,000	0.18	Flat
2	Good	−	250,000	0.175	Fair
3	Good	−	140,000	0.17	Good
4	Good	−	100,000	0.165	Good
5	Good	+	180,000	0.155	Flat
6	Slightly gassy	−	90,000	0.165	Fair
7	Good	+	250,000	0.16	Fair
8	Good	+	100,000	0.165	Good
9	Good	−	500,000	0.17	Flat
10	Good	+	300,000	0.165	Fair
11	Good	+	300,000	0.165	Good
12	Good	−	90,000	0.17	Good
13	Good	−	90,000	0.155	Good
14	Good	+	100,000	0.16	Good
15	Good	−	100,000	0.16	Fair

TABLE 2

Milk from second herd fed moldy silage

NUMBER OF COW	FERMENTATION TEST	ALCOHOL TEST	BACTERIA COUNT	ACID TEST	FLAVOR AND ODOR
1	Slightly digested	+	50,000	0.16	Good
2	Good	+	100,000	0.17	Fair
3	Slightly gassy	+	75,000	0.155	Off, flat
4	Good	−	75,000	0.18	Good
5	Good	−	60,000	0.185	Good
6	Good	+	85,000	0.16	Fair
7	Slightly digested	−	100,000	0.165	Good
8	Good	+	100,000	0.155	Good

in the first case led us to believe that the silage might be causing the trouble here, so the farm was visited at once. The cows of this herd had not yet been on pasture. We examined the concentrates and hay and found nothing in them that would tend to cause a disorder in the cows, but the silage, as in the first case,

was moldy. This silo also was nearly empty. We took the liberty of feeding each cow a forkful of silage, and found that some accepted while others refused it. Correlation between the silage and the reaction was again in evidence, as those accepting the feed reacted positively, while those refusing it reacted negatively. At our suggestion the silo was emptied and the cows put on a different ration, and within a few days the reaction of the herd milk went from positive to negative.

Throughout the rest of the year, alcohol tests were made on the herd milk, but no cases of abnormal milk were found. But in April, of this year, a case similar to those of 1921 came up, and as there was enough silage left, a series of experiments was immediately begun. The silage here was moldy around the outside and also in spots through the center. The farm was

TABLE 3

Milk from third herd fed moldy silage

NUMBER OF COW	FERMENTATION TEST	ALCOHOL TEST	BACTERIA COUNT	ACID TEST	FLAVOR AND ODOR
1	Good	+	2,500	0.155	Good
2	Good	+	18,000	0.15	Good
3	Good	+	20,000	0.155	Good

visited, and the three cows of this herd whose milk reacted positively to the alcohol test were isolated. Cow 1 was put on a ration from which the silage was eliminated, and cow 2 was fed normally, as a check. For the reason that some rich clover hay was being fed, cow 3 was fed a ration with silage, but with the clover hay eliminated. On the fifth day, the milk from cow 1 cleared up in the alcohol test, while the milk from cows 2 and 3 continued to react positively. Cow 1 was then put back on silage, and in four days her milk again reacted positively. The experiment was then changed, putting cow 2 on a ration without silage and using cows 1 and 3 as a check. In four days the milk from cow 2 reacted negatively to the test. By this time the silage was gone and we were, therefore, forced to discontinue the experiment. Table 3 shows the results of the preliminary tests:

It might be well to state that cow 1 was in the middle of her lactation period and cow 2 near the end, while cow 3 was fresh.

A graphic illustration (fig. 1) will perhaps show better the outline and results of the experiment.

In our estimation, the above experiment would tend to prove that in some cases poor silage will affect the physiological condition of the cow in such a way as to cause her milk to become abnormal. It would seem quite evident that in the three cases enumerated, the silage was the cause of the abnormal milk; and if it were possible to make a complete analysis of the cows' milk and the silage, it would perhaps determine the exact cause for

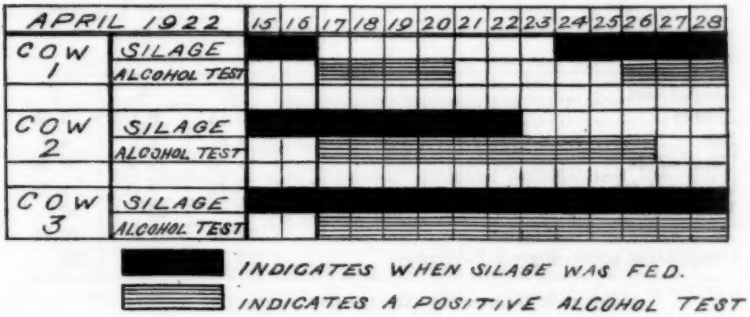


FIG. 1

this disorder. However, it is rather doubtful whether chemical analysis would disclose the reason for this change. Ayers and Johnson (6) have shown that a positive alcohol test indicates some change in the milk from its normal condition, and their results also show that there is no definite relation between the alcohol test and the number of bacteria present in the milk. It would, therefore, be safe to say that this physiological disorder has induced a chemical change in the milk which causes it, when tested with alcohol, to coagulate.

TESTS WITH EVAPORATED MILK

Dahlberg and Garner (7), in their work on determining the quality of milk for condenseries, have found that the alcohol test,

in some cases, is very valuable, while in others it has not proved satisfactory. However, they found at the Grove City creamery, in the case of milk reacting positively, the sterilization point of the evaporated milk was very low. We, therefore, ran some of the milk from each cow through our laboratory condenser, to determine whether a variation in their coagulating points could be found from the time the milk reacted positively until after it had changed from positive to negative. Table 4 shows the results obtained.

TABLE 4

Condition of evaporated milk from cows in feeding experiment

	cow 1	cow 2	cow 3
Alcohol test	+	+	+
Acidity	0.15	0.155	0.15
Fat	4.6	4.3	4.0
Total solids	14.02	13.90	13.18
Solids not fat	9.41	9.60	9.18
Forewarming temperature, degrees Fahrenheit	90	92	90
Total solids on evaporation	26.92	27.01	26.14
Coagulating point, degrees Fahrenheit	215	222	228
After milk from cow 2 had changed to negative reaction			
Alcohol test	+	−	+
Acidity	0.155	0.15	0.165
Fat	4.65	4.2	4.2
Total solids	14.02	13.4	13.52
Solids not fat	9.37	9.2	9.32
Forewarming temperature, degrees Fahrenheit	90	90	90
Total solids on evaporation	26.50	26.95	27.05
Coagulating point, degrees Fahrenheit	214	230.5	226

It will be noted that there is a difference of 8.5°F. in the coagulating temperature of the milk of cow 2, while for Cows 1 and 3 the change was 1 and 2°F., respectively. This would tend to show that a positive-reacting milk has a lower coagulating point in the case of abnormal milk, and that as soon as it becomes normal or the cause of the abnormality is removed, the coagulating point rises.

In conclusion, we wish to point out that the alcohol test is of value in determining some cases of abnormal herd milk, and especially those which would prove to be harmful to condenseries. We also believe that a poor quality of silage must be watched, so that no ill effects may come from it. As stated before, there can be no other conclusions drawn in the cases enumerated, than that the silage was the cause of the abnormal milk.

We are also inclined to believe that the mono- and dibasic phosphate salts played an important part in the phenomena we have described.

REFERENCES

(1) MORRES, WILHELM 1909 Zur Alkoholprobe der Milch. Molkerei-Zeitung, Hildesheim, xxiii, no. 47, 1319–1321.

(2) CAMPBELL, H. C. 1911 Biochemic reactions and the bacterial count of milk. U. S. Dept. Agr., B. A. I. 28th Ann. Rpt., p. 195–224.

(3) ERNST, WILHELM 1913 Grundriss der Milchhygiene für Tierärzte, Stuttgart, p. 274.

(4) AUZINGER, AUGUST 1909 Studien über die Alkoholprobe der Milch, ihre Verwendbarkeit zum Nachweis abnormer Milchen und ihre Beziehungen zu anderen Prüfungsmethoden pathologischer Milch. Milchw. Zentbl., v, no. 7, 293–315; no. 8, 352–370; no. 9, 393–413; no. 10, 430–446. Leipzig.

(5) HUNZIKER, O. F. 1914 Condensed milk and milk powder, 28–29.

(6) AYERS, S. H., AND JOHNSON, W. T., JR. 1915 The alcohol test in relation to milk. U. S. Dept. Agr., Bul. 202.

(7) DAHLBERG, A. O., AND GARNER, H. S. 1921 The alcohol test as a means of determining quality of milk for condenseries. U. S. Dept. Agr., Bul. 944.

STUDIES IN MILK SECRETION

X. RELATION BETWEEN THE MILK YIELD OF ONE LACTATION AND THE MILK YIELD OF A SUBSEQUENT LACTATION IN GUERNSEY ADVANCED REGISTRY CATTLE[1]

JOHN W. GOWEN

Maine Experiment Station, Orono, Maine

Received for publication March, 1922

To be worthy of consideration an advanced registry record must do two major things: First it must predict with reasonable accuracy what the production of that cow will be in subsequent lactations; second, it should indicate, in some degree at least, what milk production may be expected of that cow's offspring. Surprising as it may seem in view of the constantly recurring assertion of the desirability of the advanced registry test, there is very little foundation of proof to support these two hypotheses. It appears beyond cavil, if an advanced registry cow who makes an excellent record on test is worthless as a subsequent milk producer or if a cow of poor test is the leader in the breed at a subsequent lactation, that the value of the advanced registry records of these cows is slight indeed. Now it may be asserted that cases can be cited which will show that the advanced registry record indicates a cow's true worth. True enough, but these are selected cases. They do not indicate the value of the test for the whole breed. It is to furnish data on this point for the advanced registry of one whole breed, the Guernsey, that this paper is written.

MATERIAL

The American Guernsey Cattle Club in its advanced registry tabulates the records of the cows which make the requirements for

[1] Paper from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 144. This paper is one of a series of investigations in animal husbandry the continued prosecution of which has been made possible by a grant to the author from the Rockefeller Institute for Medical Research.

entry. In volume 31 of this registry there are found to be 738 possible pairs of these tests and retest for cows under ten years old. From these data the necessary tables were formed to determine the relationship between the milk production of one lactation and that of another. These tables are shown in the appendix to this paper. Because of the effect of age on yield it was deemed advisable to divide the data into year groups up to the age of seven years. The ages of seven, eight, and nine years are grouped together. The precautions taken by the cattle clubs and the supervision of the records by competent men should make these data accurate.

The methods used are those in ordinary biometrical use.

MEAN MILK YIELD OF GUERNSEY TEST AND RETEST COWS

The average milk yield for each of the different age groups is shown in table 1.

The columns represent the mean milk yields of the age group indicated above the column. The groups within that age for which the milk yields are subsequently correlated are shown at the left as the age at which the retest was made. Thus the first mean in the two-year column, 8519 $\pm$ 129, shows that these two-year-olds mean milk yields was 8519 $\pm$ 129 pounds and that these same cows were subsequently tested at three years old. Similarly the mean milk yield of the two-year-olds subsequently retested at four years old was 8248 $\pm$ 104. The mean milk yield of the three-year-old cows tested at two years is given in column headed three years in the two-year row as 10349 $\pm$ 163.

Table 1 shows several significant points. The milk yields for these two-year-old cows tested at subsequent dates are approximately the same as those of the average two-year-old advanced registry Guernsey cows. This means that no selection of better milking cows for subsequent retest has taken place within this two-year-old group.

If the column for the three-year-old cows is compared with the average of the advanced registry Guernsey cattle, it is found that the three-year-old cows which were tested at two years old produced in their three-year-old lactation something over 1300

TABLE 1

Average milk yield of Guernsey test and retest cows

AGE WITH WHICH CORRELATED	AGE CORRELATED						
	2 years	3 years	4 years	5 years	6 years	7, 8, 9 years	7 years
years	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*
2		10349±163	10630±150	12274±225	11864±237	11545±239	
3	8519±129		10791±229	11709±226	11971±282	11647±240	
4	8248±104	9027±186		10924±271	11738±264	12420±350	
5	8311±168	9267±221	9136±189		11778±343	12000±240	
6	8659±186	9294±261	9810±239	10556±251		12368±350	
7, 8, 9	7545±142	8324±191	9300±219	9969±200	10494±243		11364±350
8 and 9							12909±359

pounds more milk than was expected of them. Examination of the three-year-old cows which were not tested for advanced registry at two years old shows their milk yield to agree, within the limits of random sampling, with the average of all the Guernsey cows tested at this age. Clearly here is proof of what fitting and care will do for increasing milk yield. But let us examine the four-year-old cows. Here the same facts are brought out. The cows tested at two years or at three years old produce more than the average advanced registry cow of four years by an amount equal to 1200 pounds on the average, whereas those cows tested for advanced registry for the first time produce practically that of the average for all the advanced cows of this breed an age. The five-year-old cows tested as two, three or four year olds produced nearly 1500 pounds of milk more than did the average of the five-year-old advanced registry cows, whereas the cows tested at five years old for the first time produced only slightly more than the average of all advanced registry Guernsey cows. The six-year-old cows when previously tested produced about 1300 pounds more milk than the average of all the advanced registry Guernsey cows of that age. The six-year-old Guernsey cows not previously tested produced practically the same milk yield as the average six year-old cows. The seven-, eight-, and nine-year old cows where previously tested, produced on the average 2,000 pounds of milk more than the average of all the advanced registry cows. These facts indicate the universality of an increase in retest milking of the Guernsey cows with previous advanced registry tests. There is no clear evidence that the difference increases significantly with the older ages and consequent increase in milk yield. The fact of the increased milk yield after a previous advanced registry test may be accounted for in at least four ways.

(a) That the previous test has enlarged and developed the udder of cows so tested beyond what it would ordinarily have been.

(b) That the owner of the cow realizing the worth of the cow due to her previous test prepares the cow better for the coming test.

(c) As a corollary to (b) that the cows get better care and feeding, in fact get extraordinary care, than they did in their first test or that any cows first tested would be likely to get.

(d) That cows, when second tested, which do not make relatively large records in the second test are not entered into the advanced registry by their owners even though they make the requirement for entry.

It is difficult to evaluate properly the relative effect of these four variables. It seems probable that (d) played but little part in the conditions cited. Thus the owner of the cow to be retested would pay $5 to start the test, plus practically $9 per month for a supervisor as long as the test was continued. This would mean on 8 cows (the maximum number which are allowed to one supervisor for 3 milkings a day) a cost per month of about $1.50 per cow. It seems highly doubtful, therefore, whether in view of the expense already made in the completion of a test the owner would deliberately keep back or withhold from the Cattle Club the names of the cows which made the requirement but did not make it by a large amount. Furthermore, with the increase in milk yield with age a cow is practically bound to increase in the actual (not her relative) yield of butter-fat. This would tend to cause all cows making the retest to be included in the advanced registry. Such a state of affairs would make (a), (b), and (c) the important factors.

These factors are strictly environmental. They represent what Galton would call nurture factor as distinct from those of nature. Here then is a measure of some environmental factors as they effect milk yield. How much are they capable of effecting milk yield? Clearly from one-sixth to one-ninth of its total amount. As a strictly biological fact where environmental causes may impose variations of so great a magnitude upon genetic characters, it devolves upon the breeder and tester of dairy cattle to make full use of this variation by carefully fitting his cows for advanced registry work.

VARIATION OF THE MILK YIELD OF GUERNSEY RETEST COWS

Table 2 gives the amount of milk which these Guernsey cows varied on their first and second tests. This is recorded as the standard deviation. Within a range of three times the standard deviation on either side of the mean will be included practically all the observed milk yields. The arrangement of the table is the same as that of table 1.

The variability within the different age groups appears to be at random. The variability of the two-year-old class is less than that of the other age classes. This is in accord with the results of other investigations (1) where it may be shown that the standard deviation of milk yield rises rapidly with age, following, in general, one form of a parabola. The percentage of this variation in comparison with the mean milk yield ranges from 14 to 25. This range is about that of most milk-producing cows and breeds when calculated from relatively small groups similar to those of these data.

RELATION BETWEEN THE MILK YIELD OF THE FIRST TEST AND OF THE RETEST

We are now in a position to obtain the answer to the problem, does an advanced registry record predict with reasonable accuracy what the production of a cow's retest will be in a subsequent lactation? The amount of the correlation coefficients for the relation between the test and retest shows the degree of reliance which can be placed in an advanced registry test as a means of predicting the subsequent milk yield of the same cow. Thus, if a cow produces the highest milk yield of all two-year-olds, will she produce the highest milk yield of all three-year-olds? That is, will a cow maintain the relative level of her production among her sister cows which she had in the previous lactation? If so the correlation coefficient will be 1.000. If it makes no difference what the first test is, whether the highest or lowest, in determining what the subsequent test will be the correlation coefficient will be zero. The range between 1 and 0 determine the value of the first test record as a prediction of the milk yield of the subsequent

TABLE 2

Differences between milk yields of Guernsey retest cows in first and second tests

AGE WITH WHICH CORRELATED	AGE CORRELATED						
	2 years	3 years	4 years	5 years	6 years	7, 8, 9 years	7 years
years	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*
2		2487±115	2379±106	2431±159	2327±167	2354±169	
3	1971±91		2520±162	2195±160	2440±200	2074±170	
4	1657±74	2044±131		2310±192	2534±186	2591±247	
5	1812±118	2144±156	1611±134		2155±242	2016±170	
6	1833±132	2259±185	2294±169	1580±178		2922±247	
7, 8, 9	1397±100	1653±135	1625±155	1677±141	2218±172		2436±248
8 and 9							2498±254

TABLE 3

Correlation coefficient for variation in milk yield in first test and retest of Guernsey cows

AGE WITH WHICH CORRELATED	AGE CORRELATED						
	2 years	3 years	4 years	5 years	6 years	7, 8, 9 years	7 years
2		0.795±0.024	0.586±0.041	0.701±0.047	0.775±0.041	0.462±0.080	
3	0.795±0.024		0.726±0.043	0.643±0.060	0.775±0.046	0.539±0.082	
4	0.586±0.041	0.726±0.043		0.750±0.051	0.725±0.049	0.661±0.076	
5	0.701±0.047	0.643±0.060	0.750±0.051		0.778±0.063	0.606±0.075	
6	0.775±0.041	0.775±0.046	0.725±0.049	0.778±0 063		0.811±0.038	
7, 8, 9	0.462±0.080	0.539±0.082	0.661±0.076	0.606±0.075	0.811±0.038		
8 and 9							0.808±0.050
Average.....	0.664	0.696	0.690	0.696	0.773	0.616	0.808

retest. The data of table 3 answers this problem for Guernsey test and retest advanced registry cows. Study of table 3 shows that the correlation coefficients for milk yield of one lactation correlated with the milk yield of another lactation are high for this kind of data. The average correlation coefficient is 0.696 when each observation is equally weighted. The magnitude of the correlation coefficient shows that the retest record may be predicted with considerable accuracy from the record of the first test. The answer to the problem set for this paper is at hand; the advanced registry test predicts with reasonable accuracy the record obtained on retest of Guernsey cows. Records of milk yield at one age are of about equal value with those of another age in predicting the cow's subsequent record.

From the practical side of culling the poor milkers out of the herd these results are highly satisfactory. The data are equally interesting when considered in their biological aspects. The correlations show that the cows composing the herd are innately differentiated in their milk-producing abilities. The plane of production once established, the cow tends to maintain this relative plane from lactation to lactation. The values of the correlations indicate clearly that there is a fairly accurately working mechanism behind this function.

From this point of view it is of a good deal of interest to compare the only other statistics available for cattle with those derived here.

In a pure-bred herd of Jersey cattle, Gowen (2) showed that the correlation coefficients for the eight months' milk production of one lactation with that of another lactation at another age ranged from $+0.2144 \pm 0.0919$ to $+ 0.7306 \pm 0.0284$. Each set of correlation coefficients for the milk production at a given age with the milk productions at other ages in the cow's life deviate only slightly from a line which is approximately linear, taking a nearly constant value for each age. The mean value for these correlation coefficients of milk production of one lactation at any age with the milk production of another lactation at another age is $+0.5352$.

On another herd composed of British Holsteins and Shorthorns Gavin, using his measure of the lactation as the "revised maximum," found the correlation between the milk productions of the various lactations and that of their maximum "revised maximum" to be those shown in table 4.

The data on the pure-bred Jersey herd and that of Gavin correspond closely. They indicate that in an unselected group of cattle a somewhat lower relation exists between the milk yield of one lactation and the milk yield of a subsequent one than is shown by the Guernsey advanced registry test and retest cows. The correlations are in all cases high and confirm each other in proving that the individual cows are innately differentiated as regards their capacity for milk production.

TABLE 4

Correlation coefficients between milk productions in various lactations of British Holstein and Shorthorn cows

LACTATION	r WITH MAXIMUM "REVISED MAXIMUM"	PROBABLE ERROR
First	+0.394	±0.031
Second	+0.452	±0.030
Third	+0.506	±0.028
Fourth	+0.605	±0.024
Fifth	+0.762	±0.016

Other relations which include productive capacity in its broad sense have been studied for dairy cattle. Eckles and Swett (3) have studied data on the relation of birth weight to the height at the withers at twenty-four months of age for the resulting calf. They say "these data possibly show a very slight tendency toward the animals larger at birth maintaining a lead over the normal during the period of most rapid growth, but individual variations are marked." The author has calculated the correlation coefficients for these data of Eckles and Swett. For the relation between birth weight and wither height of the 13 Holstein-Friesian heifers the correlation coefficient is 0.29; for the 12 Jersey heifers 0.24. The conclusion of Eckles and Swett to this extent appears justified. However, when it is realized

that on samples of the size of 13 and 12 correlation coefficients of this amount would have an equiprobable range of not less than 0.20 on either side of this value, the conclusions, based on such small numbers, lose weight.

Of the quantitative data on other species of practical interest perhaps the most complete is that of Harris and Blakeslee (4) (1918) on the White Leghorn. In this work they determined the correlations between the monthly egg production and the other eleven months production of the same bird. The correlations for these monthly ovulations with the other eleven months ovulation takes values ranging from $+0.240 \pm 0.033$ to $+ 0.573 \pm 0.023$. The range is there quite similar to those obtained in the data for milk yield in cattle although lower in value. The knowledge of these sets of constants gives criteria for the fairly accurate prediction of the records that may be expected at a subsequent date in the life of these extremely economically important species.

PREDICTION OF RETEST MILK YIELD FROM FIRST TEST MILK YIELD

To predict one variable from another as the milk yield of one lactation from that of another lactation, it is necessary to know the numerical relations between the variables. These may be determined in the form of equations. The equations to predict the probable yield on the second test of Guernsey cattle making advanced registry test have been calculated. These are given in table 5.

In the equations of table 5 Y represents the desired predicted milk yield at the subscript age and y indicates the milk yield at the age given as the subscript to y. Thus a cow at two years old gave a milk yield of 8000 pounds, what would be the expected advanced registry milk yield at six years of age. We find the Y of six years and y of two years in the fourth equation of column 2. The equation is

$$Y_6 = 3347 + 0.984y_2$$

substituting, we have $Y_6 = 3347 + 0.984 \times 8000$, or the expected milk yield at six years of age is 11,219 pounds. In the same manner the predicted milk yield of any age may be found.

TABLE 5

Equations to predict the probable yield of Guernsey advanced registry cows on second test

$Y_2 = 1{,}994 + 0.630y_3$	$Y_2 = 1{,}803 + 1.003y_2$
$Y_2 = 3{,}908 + 0.408y_4$	$Y_4 = 3{,}686 + 0.842y_2$
$Y_2 = 1{,}897 + 0.523y_5$	$Y_5 = 4{,}458 + 0.940y_2$
$Y_2 = 1{,}414 + 0.611y_6$	$Y_6 = 3{,}347 + 0.984y_2$
$Y_3 = 4{,}378 + 0.274y_{7,8,9}$	$Y_{7,8,9} = 5{,}669 + 0.779y_2$
$Y_3 = 2{,}678 + 0.588y_4$	$Y_4 = 2{,}713 + 0.895y_3$
$Y_3 = 1{,}913 + 0.628y_5$	$Y_5 = 5{,}610 + 0.658y_3$
$Y_3 = 704 + 0.718y_6$	$Y_6 = 4{,}190 + 0.837y_3$
$Y_3 = 3{,}316 + 0.430y_{7,8,9}$	$Y_{7,8,9} = 6{,}016 + 0.677y_3$
$Y_4 = 3{,}422 + 0.523y_5$	$Y_5 = 1{,}099 + 1.075y_4$
$Y_4 = 2{,}108 + 0.656y_6$	$Y_6 = 3{,}885 + 0.801y_4$
$Y_4 = 4{,}150 + 0.415y_{7,8,9}$	$Y_{7,8,9} = 2{,}613 + 1.055y_4$
$Y_5 = 3{,}833 + 0.571y_6$	$Y_6 = 570 + 1.062y_5$
$Y_5 = 3{,}923 + 0.504y_{7,8,9}$	$Y_{7,8,9} = 4{,}742 + 0.728y_5$
$Y_6 = 2{,}852 + 0.616y_{7,8,9}$	$Y_{7,8,9} = 1{,}172 + 1{,}069y_6$
$Y_7 = 1{,}189 + 0.788y_8$ and $_9$	Y_8 and $_9 = 3{,}492 + 0.829y_7$

SUMMARY

This study presents the data on the Guernsey breed to determine the worth of an advanced registry record for milk yield as an indicator of the milk yield of a subsequent lactation. The major conclusions may be stated briefly.

Environment may materially effect the milk yield of a cow. Thus Guersey cows on retest produced over 1000 pounds milk more than their sisters on first test at the same age.

The variation of Guernsey milk yield agrees with that of the other breeds.

The relation of the milk yield of one lactation to that of another is high, ranging from 0.462 to 0.811 in the correlation scale. Compared with a pure-bred herd of Jerseys, the average coefficient of correlation is nearly 0.15 higher for the Guernsey advanced registry cattle than it is for the Jerseys. Compared with the records for egg production, the Guernsey milk records indicate with much greater accuracy what the subsequent retest milk record will be than do the egg records for one month indicate what the subsequent eleven months' egg record will be for White Leghorn hens.

Equations are presented to determine from one lactation's advanced registry record what will be the probable record at a subsequent lactation.

APPENDIX

TABLES SHOWING THE CORRELATION SURFACE FOR THE VARIABLE MILK YIELD OF ONE LACTATION WITH THE MILK YIELD OF ANOTHER LACTATION. EACH LACTATION IS AT A KNOWN AGE

3-YEAR-OLDS' MILK YIELD (POUNDS)	2-YEAR-OLDS' MILK YIELD (POUNDS)											
	4,000 to 5,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000 to 15,000	
5,000 to 6,000		1										1
6,000	1	2	2	3								8
7,000		1	9	1								11
8,000		1	2	5	4	1						13
9,000		2	1	6	6	2	1					18
10,000			1	3	4	5	1					14
11,000				3	1	6	3					13
12,000				1	1	4	8	1				15
13,000			1	2		3						6
14,000								1	1	1		3
15,000									1			1
16,000										1	1	2
17,000												
18,000 to 19,000											1	1
	1	7	16	24	16	21	13	2	2	2	2	106

4-YEAR-OLDS' MILK YIELD (POUNDS)	2-YEAR-OLDS' MILK YIELD (POUNDS)								
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000 to 13,000	
5,000 to 6,000	1								1
6,000		1	1						2
7,000	4	2	3	1	2	1			13
8,000	3	7	3	3	1	1			18
9,000	1	4	8	3	2				18
10,000		3	5	4	3				15
11,000			2	5	1	3	1		12
12,000			2	6	2	5			15
13,000		1	3	1	3	2	1		11
14,000			1		3		1	1	6
15,000			1		1				2
16,000 to 17,000								2	2
	9	18	29	23	18	12	3	3	115

5-YEAR-OLDS' MILK YIELD (POUNDS)	2-YEAR-OLDS' MILK YIELD (POUNDS)										
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000 to 15,000	
7,000 to 8,000	2										2
8,000	3	2	1	2	1						9
9,000		1	4	1							6
10,000		3	5	1	2						11
11,000	1		2		3						6
12,000			1	1	4	3					9
13,000						3					3
14,000						1					1
15,000		1			2	1					4
16,000					1						1
17,000											
18,000 to 19,000										1	1
	6	7	13	5	13	8				1	53

6-YEAR-OLDS' MILK YIELD (POUNDS)	2-YEAR-OLDS' MILK YIELD (POUNDS)											
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000 to 16,000	
7,000 to 8,000	1											1
8,000		1	1									2
9,000		2	3	1								6
10,000	1	1	2	3	1							8
11,000		1		5	1	2						9
12,000		1	1	3	1	2						8
13,000					1							1
14,000				2	1		2					5
15,000						2						2
16,000						1						1
17,000												
18,000												
19,000 to 20,000											1	1
	2	6	7	14	5	7	2				1	44

7-, 8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	2-YEAR-OLDS' MILK YIELD (POUNDS)						
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000 to 11,000	
8,000 to 9,000	1	4					5
9,000	3	1	2	2	1		9
10,000	1	3	1	1	1		7
11,000		2	2	1	2		7
12,000		2	2	1			5
13,000			2	1	1	1	5
14,000		1	1				2
15,000			1				1
16,000						1	1
17,000 to 18,000			1			1	2
	5	13	12	6	5	3	44

4-YEAR-OLDS' MILK YIELD (POUNDS)	3-YEAR-OLDS' MILK YIELD (POUNDS)										
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000 to 15,000	
5,000 to 6,000	1										1
6,000			1								1
7,000	1	3			1			1			6
8,000		2	1	1	1						5
9,000			3	5		1					9
10,000		1	2	4		2					9
11,000		1	2	2	4	1					10
12,000				1	2						3
13,000						1	2		1		4
14,000						1	2				3
15,000						1		1	1		3
16,000											
17,000 to 18,000										1	1
	2	7	9	13	8	7	4	2	2	1	55

5-YEAR-OLDS' MILK YIELD (POUNDS)	3-YEAR-OLDS' MILK YIELD (POUNDS)													
	6,000 to 7,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000 to 19,000	
7,000 to 8,000		1												1
8,000														
9,000	1	1	3	2		1								8
10,000	3	2	2	2		1								10
11,000		1	3	4		1								9
12,000		1	1	1	1	1								5
13,000		2	1		2									5
14,000				1										1
15,000						1	1							2
16,000														
17,000							1							1
18,000 to 19,000													1	1
	4	8	10	10	3	5	2						1	43

6-YEAR-OLDS' MILK YIELD (POUNDS)	3-YEAR-OLDS' MILK YIELD (POUNDS)										
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000 to 15,000	
7,000 to 8,000	1										1
8,000	1		1								2
9,000		2	1								3
10,000	1	1	1	1	3						7
11,000				1	1	1	3				6
12,000			2		3	1					6
13,000					1	1	1				3
14,000					1	1					2
15,000						1				1	2
16,000									1		1
17,000											
18,000											
19,000 to 20,000									1		1
	3	3	5	2	9	5	4		2	1	34

7-, 8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	3-YEAR-OLDS' MILK YIELD (POUNDS)								
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000 to 13,000	
8,000 to 9,000	1	2							3
9,000			1	1			1		3
10,000		1	3	4					8
11,000	1	1	2	2	2	1			9
12,000		1	1	1	1				4
13,000				1	1				2
14,000		1				2			3
15,000									
16,000						1			1
17,000 to 18,000								1	1
	2	6	7	9	4	4	1	1	34

5-YEAR-OLDS' MILK YIELD (POUNDS)	4-YEAR-OLDS' MILK YIELD (POUNDS)									
	5,000 to 6,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000 to 14,000	
7,000 to 8,000	1		1	2	1					5
8,000			1							1
9,000			1	3						4
10,000			3	6		2				11
11,000					1	1				2
12,000					2	1	1			4
13,000				1	1					2
14,000						1	1			2
15,000									1	1
16,000 to 17,000								1		1
	1		6	12	5	5	2	1	1	33

6-YEAR-OLDS' MILK YIELD (POUNDS)	4-YEAR-OLDS' MILK YIELD (POUNDS)										
	6,000 to 7,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000 to 16,000	
6,000 to 7,000	1										1
7,000											
8,000		1	1	1							3
9,000		4	1								5
10,000		3	2	2	1						8
11,000			5	2	1	1	1		1		11
12,000			2	1	1	1	1				6
13,000				1							1
14,000							1				1
15,000				1		1			1		3
16,000										1	1
17,000										1	1
18,000											
19,000 to 20,000							1				1
	1	8	11	8	3	3	4		2	2	42

7-, 8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	4-YEAR-OLDS' MILK YIELD (POUNDS)							
	7,000 to 8,000	8,000	9,000	10,000	11,000	12,000	13,000 to 14,000	
8,000 to 9,000	2							2
9,000	1	2						3
10,000	1	1	1					3
11,000	1		2	1				4
12,000		4						4
13,000		1	1		1	1		4
14,000								
15,000								
16,000			3				1	4
17,000 to 18,000						1		1
	5	8	7	1	1	2	1	25

6-YEAR-OLDS' MILK YIELD (POUNDS)	5-YEAR-OLDS' MILK YIELD (POUNDS)							
	7,000 to 8,000	8,000	9,000	10,000	11,000	12,000	13,000 to 14,000	
7,000 to 8,000			1					1
8,000	1							1
9,000			1					1
10,000			1	1				2
11,000		1	3	3				7
12,000						1		1
13,000					1	1	1	3
14,000								
15,000						1		1
16,000 to 17,000						1		1
	1	1	6	4	1	4	1	18

7-, 8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	5-YEAR-OLDS' MILK YIELD (POUNDS)								
	6,000 to 7,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000 to 14,000	
8,000 to 9,000	1		1						2
9,000	1	1	2						4
10,000				3	1				4
11,000			1			5			6
12,000				5	1	1			7
13,000			1	1	1			1	4
14,000				1	1		1		3
15,000									
16,000 to 17,000					1			1	2
	2	1	5	10	5	6	1	2	32

7-, 8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	6-YEAR-OLDS' MILK YIELD (POUNDS)										
	7,000 to 8,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000 to 17,000	
8,000 to 9,000	1	2									3
9,000	3		2								5
10,000	1	1	2	1							5
11,000		1	2	3	1						7
12,000		2		3	1	1					7
13,000				1	1	1					3
14,000							1	1			2
15,000											
16,000					1	1	1		1		4
17,000											
18,000											
19,000					1						1
24,000 to 25,000										1	1
	5	6	6	8	5	3	2	1	1	1	38

8- AND 9-YEAR-OLDS' MILK YIELD (POUNDS)	7-YEAR-OLDS' MILK YIELD (POUNDS)												
	7,000 to 8,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000 to 19,000	
9,000 to 10,000		1											1
10,000	1	1	1	1									4
11,000			1	3	2		1						7
12,000					1								1
13,000				1									1
14,000				1	2	1							4
15,000					1		1						2
16,000													
17,000												1	1
18,000													
19,000 to 20,000										1			1
	1	2	2	6	6	1	2			1		1	22

REFERENCES

(1) GOWEN, JOHN W.: Studies in milk secretion. V. On the variations and correlations of milk secretion with age. Genetics, 1920, v, no. 2, 111–188, 51 tab. (in text and on pl.). Literature cited, p. 186–188.

(2) GOWEN, JOHN W.: Op. cit.

(3) ECKLES, C. H., AND SWETT, W. W.: Some factors influencing the rate of growth and the size of dairy heifers at maturity. Mo. Agr. Exp. Sta. Research Bul. 31, 1918, 56 p., 16 fig. (in text and on pl.). Bibliography, p. 56.

(4) HARRIS, J. ARTHUR, BLAKESLEE, A. F., AND WARNER, D. E.: The correlation between body pigmentation and egg production in the domestic fowl. Genetics, 1917, ii, no. 1, 36–77. Literature cited, p. 77.

ACIDITY OF BUTTER AND ITS BY-PRODUCTS

F. W. BOUSKA

Superintendent of Manufacturing, Beatrice Creamery Company, Chicago, Illinois

Received for publication December 11, 1922

From the very beginning of the science of buttermaking, the acidity of cream has received much attention. At first because it was found to have an important influence upon the immediate flavor of butter. In the past decade the importance of acidity has increased because of the discovery that it profoundly affects the keeping quality as well as the immediate flavor of butter. It has been presumed too much that if the acidity of cream is right the butter will be right in so far as it is affected by acidity.

The acidity of cream comes to effect as acidity in the butter. It is the acidity in the butter that affects its flavor and keeping quality. Even though the churning acidity of cream is right the acidity of butter may be high if the butter is overchurned or if the butter is not properly washed.

The source of the acidity of cream is almost entirely in its serum or butter milk. Milk fat is neutral so far as its register upon the acid test of cream is concerned. About one half of the acidity of butter, tested with alcohol and ether, is due to buttermilk, the other half to the fat itself. If the acidity of butter is tested without a fat solvent like alcohol and ether, then the acidity measured is practically all due to butter milk.

Thorough and convenient removal of buttermilk is very desirable.

Butter granules of visible size either large or small are aggregates or clumps of smaller granules. The constitution of a butter granule can be illustrated with a barrel of apples. The barrel is full of apples and not another apple could be added. The contents of the barrel are not all apples. The spaces between the apples are occupied by air. Likewise, a visible butter

granule is not all milk fat. The spaces between the microscopic granules composing the large granule are full of buttermilk.

For the purpose of the problem in hand, granules the size of filberts are aggregates of granules of the size of wheat. It is obvious that wash water has a much greater distance to travel in flowing through a granule the size of a filbert than in flowing through a granule the size of wheat. Moreover, because of its greater weight and longer churning, the surface of the larger granule is sealed to a greater extent than the surface of the smaller granule.

The smaller the granules, therefore, the more buttermilk can be washed out of them. If the granules are smaller than radish seed they drain so slowly that the method is impractical. I prefer granules the size of wheat.

Churning at a warm temperature will produce poorer results because butter comes so quickly that overchurning will often occur.

Before washing is completed the churn should not be turned unless the granules are floating on butter milk or water. Unless this foresight is used, the turning of the churn causes the mass of granules to fall with such impact that they are jammed together.

When the draining buttermilk flows a stream the size of the thumb the granules which have gently settled to the bottom in an open fluffy heap should be sprayed with water until the drainings (the bung is open all this time) become watery. The bung is then closed and water added to a depth of 6 to 12 inches. Whichever depth is chosen should be uniform from churning to churning. For 1000 pounds of butter about 100 gallons of water is required.

When sufficient water has been added the churn is revolved two or more turns in the slow gear. The water is drained through the bung and another dose of water added as before. The churn is again revolved in the slow gear or the butter is worked in the wash water, according to whether the buttermaker salts in the granular form or works his butter in the wash water. I prefer working in the wash water.

The history of the acidity of a churning was as follows:

1800 pounds of cream, fat 32½ per cent

	PERCENTAGE	DEGREES MANNS'
Churning acidity	0.31	17.5
Acidity of buttermilk	0.47	26.0
Acidity rinse water (20 gallons)	0.24	13.3
First wash water (100 gallons)	0.17	9.3
Second wash water (100 gallons)	0.027	1.4
Acid of butter (AE)	0.14	
Size of granules	Wheat	
Butter produced (pounds)	716	

This is an actual and representative churning.

The decreasing acidity of the wash water indicates the removal of buttermilk and acidity from the butter. An acidity of wash water of 0.014 per cent (0.8 degree Manns') is as good as is practically possible.

It should be seriously borne in mind that large granules, say the size of filberts, very quickly yield wash water of low acidity. Large granules do not allow the water to enter and low acidity is due to slight removal or buttermilk.

An (AE) acidity of 0.14 per cent in the butter is average. The greater acidity in the butter than in the second wash water is due to the casein which is acid, as well as the fat which is also acid to the test here applied.

To make such copious washing practical it is necessary to provide convenient facilities therefor. The water is held at even temperature in a tank or vat provided with thermometer and regulators as desired. A three inch pipe line is installed behind the churns. A branch for each churn passes over the main churn bearing at the gear end. This terminates in a short length with two elbows, one of which is loose. This short length hangs down out of the way when not needed and swings to the left into the churn door when needed (see figs. 1 and 2).

To supply standardized amounts of wash water so the butter would be properly washed and brought to uniform hardness for

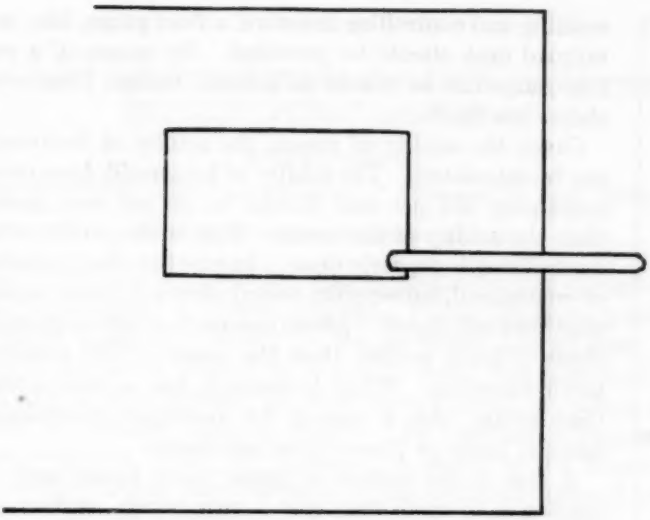


FIG. 1

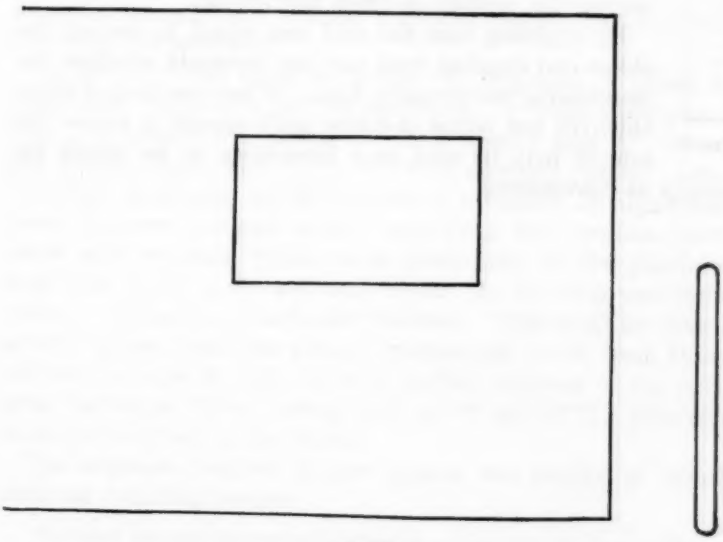


FIG. 2

FIG. 3

working and controlling moisture, a float gauge, like on a railroad tank should be provided. By means of a cord this gauge can be placed so it could be seen from every churn (see fig. 3).

Given the acidity of cream, the acidity of buttermilk can be calculated. The acidity of buttermilk from cream containing 33⅓ per cent should be 50 per cent greater than the acidity of the cream. This is the acidity when neutralizing is properly done. In practice about one-half of centralized buttermilks tested shows a lower acidity than that calculated. About one-tenth of the buttermilks shows a lower acidity than the cream. This condition needs attention. When buttermilk has a lower acidity than cream, this is caused by improper neutralizing, namely, haste or lime of poor solubility.

A test of the acidity of butter takes longer and the reading is so small that only a very careful worker can make a reliable test. These objections do not apply to testing the acidity of fresh buttermilk.

By applying here the acid test which is one of the oldest and simplest tests one can ascertain whether the neutralizing was properly done. When one drop of formaldehyde per ounce of butter milk sample is added the sample may be sent to a laboratory to be tested for acidity at convenience.

A ROPY MILK ORGANISM ISOLATED FROM THE FINNISH "PIIMA" OR "FIILI"[1]

HAROLD MACY

Dairy Bacteriology Laboratory, University of Minnesota, St. Paul, Minnesota

Received for publication October 15, 1922

A bottle of milk, decidedly ropy in character, was brought to our laboratory by a Finnish student. It has not been possible to obtain a complete history of the beverage, but we were informed that some relative of a grocery man, who dispensed it, had sent to him through the mail from Finland, a culture absorbed in ordinary blotting paper. The beverage is known to these people as "Fiili" or "Piima." A search of the literature has failed to reveal any reference to this particular type of ropy milk. Inquiries made among investigators in this country have not yielded any information regarding it. Others have been consulted, among them editors of Finnish papers, but no scientific data was available.

An attempt was made to isolate the organism or group of organisms, responsible for the condition. A fresh twenty-four hour propogation was plated on "milk powder agar A" (Ayers and Mudge, Jour. Bact., v, 6, 565) with excellent results. After five days incubation at 20°C., besides a variety of organisms, there appeared colonies closely resembling the common Bact. lactis acidi colonies, which when penetrated by the platinum loop were found to be soft and viscid. As the loop was withdrawn, a threadlike attachment followed. This could be drawn several inches from the plate. Inoculations made from these colonies into sterile milk led to a decided ropiness of the milk after twelve to fifteen hours, both at 20 and 37°C., although more pronounced in the former.

The organism isolated in pure culture was studied in detail with the following results:

[1] Published with the approval of the Director as Paper No. 340, Journal Series, Minnesota Agricultural Experiment Station.

MORPHOLOGY

Shape: Microscopically, the organism resembles the Streptococcus lacticus, occurring as small cocci, slightly longer than broad. In preparations from milk, bouillon, or agar, there was very little difference in the appearance of the organism.

Size: From twenty-four hour milk cultures, varied in size from 0.6 to 1.2 micron with the majority from 0.8 to 1 micron.

Arrangement: Occurred in pairs and in chains of from 4 to 20 individuals, the majority being between 6 and 10.

Capsules: Were not always evident but a thin capsule was noted in some cases when stained with carbol fuchsin.

Motility: None.

Spores: None.

Staining: Stained readily with the ordinary aniline stains. Strongly Gram positive.

CULTURAL

Plain agar: No growth.

Lactose agar plates: No growth.

Lactose agar stroke: No surface growth.

Lactose agar stab: Very slight growth along line of puncture, better near surface.

Milk powder agar plates: Colonies subsurface, white to cream colored, very viscid, bi-convex discs, about 1 mm. long by 0.25 mm. greatest diameter.

Milk powder agar stroke: Moderate, beaded, flat, smooth, whitish, to transparent, tenacious on surface. Viscid growth in water of condensation.

Milk powder agar stab: Slight growth along line of puncture, better near surface.

Plain gelatin plates: No growth.

Lactose gelatin plates: No growth.

Lactose gelatin stab: Slight growth at surface. Beaded along line of puncture. Better near surface. No liquefaction.

Plain nutrient bouillon: Clear. Slight sediment, slightly viscid on agitation.

PHYSIOLOGY

Glucose bouillon: No gas. Acid. Clear. Slightly viscid sediment.

Lactose bouillon: No gas. Acid. Slightly cloudy. Viscid sediment.

Saccharose bouillon: No gas. No acid. Clear. Slightly viscid sediment.

Maltose bouillon: No gas. Acid (strong). Cloudy. Viscid sediment.

Inulin bouillon: No gas. No acid. Clear. Slightly viscid sediment.

1 per cent aqueous solutions:

Glucose: Very slight acid. No ropiness.

Lactose: Acid. Slight ropiness.

Saccharose: No acid. No ropiness.

Maltose: Acid. Ropy.

Peptone (Bacto): Slightly acid. Ropy.

Egg albumin: Slightly acid. No ropiness.

Egg albumin and glucose: Slight acid. No ropiness.

Peptone and lactose: Acid. Slight ropiness.

Peptone and maltose: Acid. Ropy.

Plain skimmed milk: Slightly acid, not sufficient to coagulate. Few flakes of precipitated casein. Decidedly ropy after twelve hours. Best at 20°C. Ropiness persists. Slight amount of ropy serum arises after standing several days. Ropiness is uniform thruout tube. It was possible to pour the milk from a second story window to the ground (about 25 ft.) without breaking the rope. Even then the wind would form an arc of the thread which descended. Milk cultures retained their ropiness even after six months and when they had dried to nearly half their original volume.

Brom cresol purple milk: Moderately acid. Ropy. pH, about 6.4 to 6.5.

Plain whole milk: Acid. Ropiness not as pronounced as in skimmed milk.

Sour milk: No ropiness produced.

Whey: Acid. Ropy.

Casein (dialyzed): Neutral. Ropy.

Casein (dialyzed and maltose: Acid. Ropy.

Casein (dialyzed) and lactose: Slightly acid. Ropy.

Chromogenesis: None.

Temperature: Optimum 20°C. Grows well 12 to 37°C.

In milk cultures: After thirty minute at 60°C.—Produced ropiness. After thirty minutes at 65°C.—produced no ropiness. After one minute at 98°C.—produced no ropiness.

Moisture requirement: Cultures dried on blotting paper were capable of producing ropiness even after six months.

Oxygen requirement: Facultative.

Miscellaneous observation: Inoculations made into sterile milk from the sugar broth cultures, two months old, caused ropiness in all cases, but in addition, the milk was coagulated and pierced with gas voids, with the exception of the culture from lactose broth, which only produced slight acidity and ropiness. When sterile milk was inoculated from these milk tubes, ropiness appeared but no coagulation or gas. It appeared like an adjustment to environmental food supply.

DISCUSSION

Some of the interesting characteristics of the organism are its failure to grow well on the ordinary routine media, its ability to produce marked, persistent ropiness in milk, and its resistance to dessication and heat. It is able to produce the ropiness from certain carbohydrate or nitrogenous compounds separately or in combination as evidenced by its action on aqueous solutions of some of the sugars, particularly lactose and maltose and on the dialized, purified casein or peptone and mixtures of them. Albumen did not appear to be a suitable material for its formation. Consequently, the combination of the casein and lactose as it occurs in milk furnishes a most suitable medium for the action of the organism. The fat does not seem to be a factor, as whole milk did not become as markedly ropy as skimmed milk. This effect might have been physical.

The organism most closely resembles the Streptococcus lacticus var. Hollandicus comb. nov. (Hammer and Buchanna, 1915) and Streptococcus taette (Olsen-Sopp 1912), but inasmuch as the characteristics described differ from those which have been ascribed to the two above and others causing ropiness in milk, and as the literature as far as available contains no reference to "Fiili" or "Piima" or the causal agent, it is suggested that it be given as a new species—Streptococcus piima.

V. SODIUM HYPOCHLORITE[1]

SOME STUDIES ON THE BACTERICIDAL ACTION OF SODIUM HYPOCHLORITE IN COW'S MILK

HARPER F. ZOLLER AND SYLVIA M. EATON

Research Department of The Nizer Laboratories Company, Detroit, Michigan

Received for publication January 10, 1923

If sodium hypochlorite possesses a phenol coefficient of such great magnitude and if it reverts into sodium chloride and oxygen upon decomposition, as it is generally claimed, the question naturally arises; why can it not be used with safety to sterilize milk?

There are many natural reasons outside of the Food and Drug Acts which preclude the possibility of its use in the above field, and we propose to discuss the natural reasons against its use, and to present new data bearing on the question. The more urgent is this investigation since sodium hypochlorite has become such a valuable disinfecting agent in food factories and dairies. In the hypochlorite disinfection of milking machines, pipe lines, pumps, vats and other utensils in the dairies and milk product factories, it is not always possible to drain the last traces of the dilute hypochlorite rinse from some of them. Consequently if fresh or pasteurized milk should be turned into or pumped through such apparatus, it will become contaminated with traces of the disinfectant. What will be the result?

In paper III of the hypochlorite series, one of us has taken up the question of the rate of destruction of NaOCl in cow's milk. The results from that study show that at constant temperatures quantities of NaOCl up to 0.02 per cent (available chlorine) are lost in the milk almost immediately without being detected in appearance, but may be detected by persons with sensitive palates. They also showed that the rate of destruction rapidly

[1] Read before a meeting of the Society of American Bacteriologists, at Detroit, Michigan, December, 1922.

increased with temperature; also that the destruction of the NaOCl in the milk resulted in the chlorination of the casein and other proteins. There seemed to be no difference between the rate of destruction in raw, pasteurized or boiled milks which signified that, if there was any selective action on the sodium hypochlorite by the reductase present in the raw and pasteurized milk, the methods of examination were too crude to identify it.

The results from that investigation, then, taught us that NaOCl actually loses chlorine to some of the constituents of milk, and that there was a limit to the quantity of the substance which would disappear in the milk in a given time. Traces may be lost entirely to the milk without detection. It remains therefore for us to determine what effect traces and excesses of sodium hypochlorite have on the bacterial flora in the milk.

METHODS OF STUDY

While these experiments are more or less preliminary, they are convincing enough for presentation.

Quantities of raw mixed market milk were obtained from the receiving station of a local milk plant on different days. These samples were divided into 1-liter portions and brought to the temperature of the experimental conditions. In two sets of experiments the temperature of sodium hypochlorite contact was 40°C. while in the others 20°C. was used.

After being brought to the observation temperature in a swift heat interchange water-bath, and immediately before the addition of the NaOCl, dilutions of the milk were made for plating, in order to determine plate count of the bacteria on the raw milk. The plating was done with milk powder agar described by us (1) in the October number of the Ice Cream Trade Journal. The milk powder agar would serve to give a qualitative aspect of any chance selective action of the hypochlorite on the lactic acid organisms and true peptonizers.

A 1 per cent solution of NaOCl served for the bactericide. Concentrations of NaOCl were added to the milk corresponding to an "available chlorine" content of 0.0001 to 0.1 per cent in

the milk. Different periods of contact were tried for the purpose of determining the rapidity and permanency of the bactericidal action.

The results of these experiments are enumerated in table 1.

The pH of 0.01 per cent Av.Cl_2 milk was 6.8–6.9, while in case of the 0.1 per cent the pH lay between 7.1–7.2.

TABLE 1

	CONCENTRATION AV. Cl_2 ADDED TO MILK	TEMPERATURE	TIME CONTACT	PLATE COUNT	BACTERIAL DESTRUCTION	FREE NaOCl (?)
	per cent	*°C.*	*minutes*		*per cent*	
Set A	None	40	Zero	5,000,000	Zero	None
	0.01	40	10	3,045,000	39.1	None
	0.001	40	10	3,020,000	39.8	None
	0.0001	40	10	4,192,000	16.1	None
Set B	None	40	Zero	1,950,000	Zero	None
	0.1	40	5	687,500	64.8	Yes
	0.1	40	15	222,500	80.8	Yes
	0.01	40	5	1,422,500	27.0	None
	0.01	40	15	702,500	64.0	None
Set C	None	10	Zero	1,825,000	Zero	None
	None	40	Zero	1,642,500		None
	0.1	10	15	863,000	52.7	Yes
	0.1	20	15	660,000	64.0	Yes
	0.1	30	15	630,000	65.6	Yes
	0.1	40	15	605,000	68.0	Yes
Set D	None	20	Zero	2,350,000	Zero	None
	0.01	20	2.5	1,596,000	32.1	None
	0.01	20	10	1,330,000	43.4	None
	0.01	20	20	1,720,000	26.8	None
	0.01	20	30	1,542,000	34.3	None
	0.01	20	120	1,775,000	24.5	None

CONCLUSIONS

In regard to cow's milk, we can say that sodium hypochlorite has a relatively low bactericidal effect, in view of its vigorous bactericidal action on the bacterial cells themselves. Only when an excess of NaOCl was present (as indicated by starch

sodium iodide test) did we consistently obtain more than 50 per cent reduction in the plate count; and then the highest obtained was 80.8 per cent. The milk is always a pinkish-yellow color in the presence of 0.1 per cent of added "available chlorine."

We can further say that the presence of the organic matter in the milk seems to protect the vitality of the organisms, as regards their power to reproduce on a milk agar plate, even after exposure to an excess of NaOCl in the milk.

This work is being continued to determine how much NaOCl and what time interval would be necessary to completely sterilize a given sample of milk, as revealed by the milk agar plate count.

A practical conclusion may be drawn here, viz., sodium hypochlorite solutions can only be used with satisfaction in a food factory as a rinsing solution, after the equipment is thoroughly washed. It must then be dilute and yet contain sufficient NaOCl to show the presence of available chlorine in the water after having passed over the last surfaces of the equipment.

THIONIN

H. J. CONN[1]

Department of Bacteriology, New York Experiment Station, Geneva, New York

Received for publication December 5, 1922

One of the infrequently used biological stains concerning which there has been so much confusion as to give trouble both to biologists and to the manufacturers and dealers supplying them with stains is thionin. A little discussion, therefore, of the uses for this stain and its synonymy seems worth while.

One of the first—perhaps *the* first—to introduce it into this country was Dr. M. P. Ravenel, then of the University of Pennsylvania. He learned to use the stain in Paris. Later going to Germany he was unable to get the desired results with the thionin found there and so he sent to France for the brand he had first used. He convinced himself that there were great differences between the thionins on the market. Returning to America he had the French dye imported from E. Cogit & Cie., of Paris.

A more recent use for this dye was suggested by Frost when he proposed his "little plate" technic for studying and counting bacteria in milk.[2] This technic was originally worked out by Dr. Frost with the French thionin imported for Dr. Ravenel. It seems to be for this purpose that there is at present the greatest demand for thionin and complaints have reached the committee from various sources that samples of a stain labeled thionin obtained in this country were not satisfactory, as they had the staining properties of the samples previously obtained from Germany instead of resembling the Cogit thionin.

An investigation of the synonymy of this stain shows what is the trouble. There are two distinctly different dyes which are often confused, one correctly called *thionin*, the other *thionin*

[1] Chairman of Commission on the Standardization of Biological Stains.

[2] W. D. Frost, Improved technic for the micro or little plate method of counting bacteria in milk, Jour. Inf. Diseases, 1921, xxviii, 176–184. See also Standard Methods of Bacteriological Examination of Milk, 3rd, ed., 1921, p. 18.

blue. The former is synonymous with Lauth's violet, a name which seldom appears in the literature, however. Unfortunately, moreover, in Frost's paper describing the "little plate" technic he specified thionin blue instead of thionin. One other fact which adds to the conclusion is that the true thionin (syn. Lauth's violet) is no longer used in the textile trade and has not been listed in Schultz's Farbstofftabellen (the recognized index of the textile dyes) since the second edition. In the present edition thionin blue is listed, however; so it is quite natural that a manufacturer not familiar with thionin might supply thionin blue in its place.

Tests have shown plainly that for staining bacteria, especially in the Frost technic, thionin is required, not thionin blue; hence those ordering this stain are advised to specify "*thionin* (syn. *Lauth's violet*)." The only place in this country where we have found this stain available in the past is the Will Corporation at Rochester, who prepared a batch of it sometime ago not being able to find it elsewhere. At the present time, the Will Corporation stock being nearly exhausted, the National Anilin Company has prepared another lot to be put into circulation which will undoubtedly be available from general supply houses in the near future.

THE COLOSTRUM PROBLEM AND IT SOLUTION

ARTHUR C. RAGSDALE AND SAMUEL BRODY

Dairy Husbandry Department, University of Missouri Columbia Missouri

Received for publication October 27, 1922

The colostrum problem as it concerns the dairyman arises in connection with the cow infected with tuberculosis or other serious disease whose progeny it is desired to raise. In such instances the newly born calf can not be allowed to nurse its mother in the natural way on account of the danger of infection. The problem is then what to feed the calf.

To solve this problem it is first necessary to get definite ideas concerning the properties of colostrum and concerning the function of colostrum in the regimen of the young calf. The following enumeration is intended to give these ideas:

1. First we will consider the quantitative chemical composition of colostrum as compared to milk. Differences in the quantitative composition with respect to the salt and fat content are not likely to be important. As far as the proteins are concerned, the differences in the concentration of casein and albumin in colostrum and milk is not very great. The concentration of casein is on the average the same in the two secretions, and the albumin content in colostrum is approximately twice that of normal milk. There is, however, an enormous difference between the globulin content of colostrum and of milk. Normal milk contains about 0.03 per cent of globulin, while colostrum contains 6 to 12 per cent globulin. This difference between milk and colostrum with respect to the globulin content seems to be very significant in view of the fact that the globulin of colostrum is identical with the globulin from blood serum, and that this is the only protein in colostrum or milk which is identical with a protein in blood (Crowther and Raistric, 1916; Wells and Osborne,

1921). The globulin seems to pass from the blood into the mammary gland unchanged.

2. A second fundamental difference between colostrum and milk relates to the immune body content. It is well known that after certain infectious diseases, for example typhoid fever in man, the blood is found to contain immune bodies, or antibodies, which serve to protect against reinfection. These bodies may be determined qualitatively and quantitatively by appropriate methods. Colostrum is known to be very rich in all types of immune bodies found in the blood of the mother animal (Famulener, 1912; Lane Claypon, 1916). The immune bodies like the globulin, seem to pass from the blood through the mammary glands unchanged.

3. A third significant fact is that the blood of the newly born calf contains neither globulin (Howe, 1921) nor immune bodies (Famulener, 1912; Little and Orcutt, 1922), neither are these substances found in the blood of the calf after a meal of normal milk. If, however, the newly born calf is given a meal of colostrum, and then the blood serum tested, it is found to contain both globulin and immune bodies. In other words, the globulin and immune bodies pass from the blood of the mother into the blood of the offspring unchanged in their passage through the mammary gland of the mother and through the alimentary tract of the young animal.

The globulin and immune bodies seem to travel together, and change together. If the globulin is separated from blood serum, it is found that practically all the immune bodies come down with the globulin fraction. During infectious diseases when the immune body content of blood rises, there is also a rise in globulin (Ledingham, 1907; for indirect evidence to the contrary see Schmidt, 1917). The concentration of immune bodies in colostrum is proportional to the concentration of globulin in colostrum (Staubli 1906; Famulener, 1912).

4. Clinical observations furnish a fourth significant fact. It is well known that breast fed children are less subject to infectious diseases such as diphtheria and measles, than are artificially fed children. Experience in our dairy herd shows this to be true with the calf. Calves that did not get colostrum were found

to be much more subject to many infectious diseases particularly scours and "enteritis" than the calves that received colostrum. The mortality of the calves which did not get colostrum was found to be much higher than of the calves which received colostrum.

From these four facts it appears that colostrum, or at any rate the globulin and immune bodies of colostrum, play a very important rôle in the regimen of the young animal. The immune bodies passing from the mother to the offspring by the way of colostrum, are of the passive, or transitory type. The concentration of these bodies in the blood of the young calf gradually diminishes; but while these passively transmitted immune bodies are diminishing, the young animal is gradually developing its own active defensive, or immune mechanism (Gewin, 1909; Ossimin, 1913). The benefits of colostrum while transitory, are evidently very important during the period of life when the animal is without its own defensive mechanism.

Since the distinctive feature of colostrum is its large globulin and immune body content, it seems clear that there is only one other substance that contains these, and that could therefore replace colostrum in part, and that is blood serum. Blood serum from a healthy cow if mixed with normal milk could undoubtedly replace colostrum; but this is hardly a practical method. Vaccines, or immune sera against the prevalent infectious diseases of the calf, such as anti-scour serum, could likewise in part replace colostrum. This in fact is recommended by Williams (quoted by Traum, 1921).

The ideal arrangement would be to disinfect the colostrum, so treat it as to inactivate the pathogenic organisms it may contain, but leave the immune bodies and globulin unchanged. Rapid freezing and thawing was found to fulfill this requirement. The passage of a high voltage current will probably accomplish the same end (Beattie and Lewis, 1913). These methods while simple enough to carry out in a chemical laboratory can not be recommended as a routine procedure to the dairyman.

A simpler method is offered by pasteurization. Those who previously have attempted to pasteurize colostrum, found that the colostrum coagulates into a solid cheese-like mass on heating and

can not therefore be fed to the calf. On reinvestigating this subject it was found that those previously attempting to pasteurize colostrum used either a flame or steam as a source of heat. Now it was found that the temperature coefficient of heat coagulation of proteins is very high, and it rises with rise of temperature (Chick and Martin, 1910) and that therefore a difference of one or two degrees in the pasteurization temperature may determine success and failure in pasteurization. By the use of steam or a flame as a source of heat it is not possible to avoid local hot zones. The particles of protein that come in contact with the steam spray or hot bottom over the flame become overheated and coagulate, while the temperature of the colostrum as a whole may be below the pasteurization temperature. For this reason a water bath was used for heating the colostrum, and the steam was used to heat the water in the bath surrounding the colostrum container. The temperature of the bath as well as of the colostrum was carefully controlled by thermometers. With this precaution it was found to be entirely safe to pasteurize colostrum without the least danger of coagulating it. From what was said concerning the high temperature coefficient of heat coagulation of protein, and the rise of the temperature coefficient with the rise of temperature, it is clear that the lower the pasteurization temperature the greater the margin of safety. The following table showing the relative time required to thicken colostrum so it flows with difficulty when tipping the container, and the time required to inactivate the organisms of tuberculosis will further illustrate this idea.

TEMPERATURE		TIME REQUIRED TO INACTIVATE THE ORGANISM OF TUBERCULOSIS IN MILK	TIME REQUIRED TO THICKEN COLOSTRUM SO IT BARELY FLOWS
Degrees C.	Degrees F.		
		minutes	
57.5	135.5		Over 14 hours
60.0	140.0	20.0	3 hours
62.5	144.5	18.5	30–40 minutes
65.0	149.0	14.0	10–15 minutes
67.5	153.5	7.5	4–5 minutes
70.0	158.0	3.0	2 minutes
72.5	162.5		70–75 seconds
75.0	167.0		45–50 seconds

The values in the table are only approximate, the exact values depending on the composition of the sample of colostrum. The composition of first milking samples of colostrum vary considerably, and the speed of heat coagulation is dependent on the concentration of the proteins, salts, and the hydrogen ions. The greater the concentration of these substances, the more rapid the thickening of the colostrum on heating. The effect of the hydrogen ions is particularly striking. The hydrogen ion concentration of colostrum is about pH 6.1 while that of normal milk is about 6.6. The coagulation time can be appreciably increased by bringing the pH of colostrum to that of normal milk by the addition of sodium bicarbonate, or milk of magnesia, or milk of lime. This is, however, not recommended as experiments showed that certain immune bodies in colostrum, particularly the amboceptors, are more thermostable at the natural reaction of colostrum than at the more alkaline reaction. It might be added that the effect of a number of other ions on the speed of heat coagulation of colostrum were studied following the ideas of Pauli (Pauli, 1903). The results do not, however, seem of sufficient significance to make their presentation worth while. From a study of the table presented above, it appears clear that it is perfectly safe to pasteurize colostrum at 140°F. and that it is not therefore necessary to add any substances to it.

Having determined that colostrum can be pasteurized without changing its physical properties, it becomes important to find out whether temperature affects its immunological properties. Experience would seem to indicate that pasteurized colostrum is in every respect as good as unpasteurized colostrum. Out of thirty-two calves in our herd that received pasteurized colostrum only two calves died—a mortality of 6 per cent. The others did as well in every respect as the calves which nursed in the natural way. Figure 1 shows growth curves of 5 experimental calves taken at random from the group. There is no constant difference in growth between the calves naturally fed, and the calves fed on pasteurized colostrum. On the other hand, out of 22 calves in our herd that received no colostrum, and fed on raw normal milk only, 7 died—a mortality of 32 per cent—results decidedly in disagree-

ment with those published by other investigators (Buckley, 1920; Traum, 1921). These comparative mortality figures

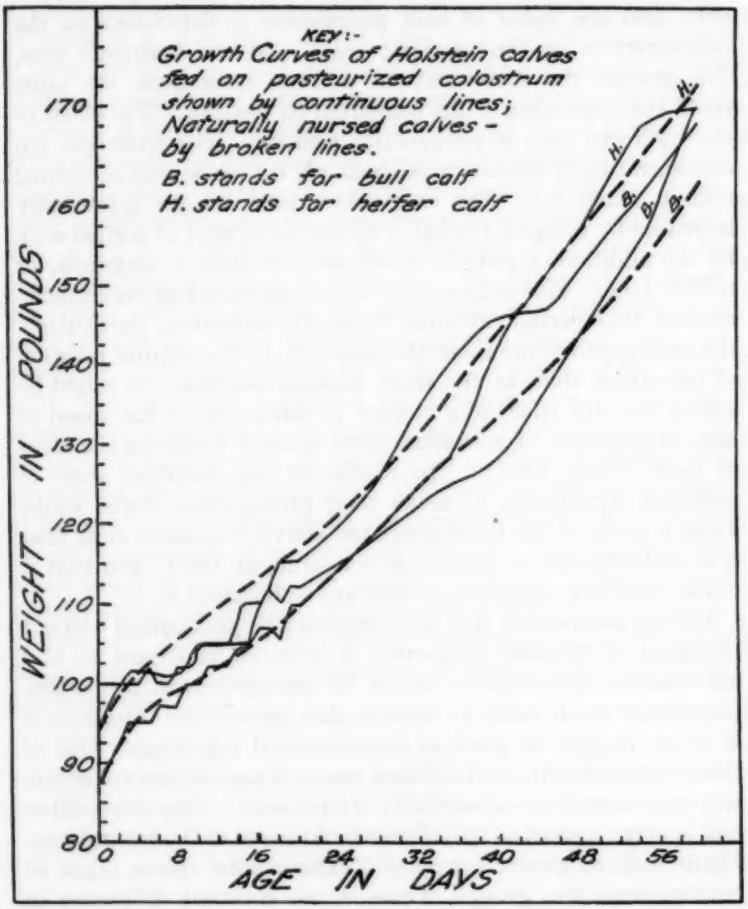


FIG. 1

show the efficacy of pasteurized colostrum and justify the conclusion that neither protein, nor immune bodies have been

materially affected by pasteurization. These conclusions have been followed up by laboratory studies on some immune bodies. The amboceptor, or complement fixing, immune body was found not to be reduced appreciably in effectiveness by heating up to 149°F. for an hour. Above this temperature this body rapidly deteriorates. Of course the complement is destroyed at the pasteurization temperature, but this is not important inasmuch as the blood of the calf contains this substance. The effect of temperature on agglutinins in colostrum is more pronounced. Further quantitative data on the effect of temperature on these bodies will be reported some time in the future when more colostrum from reacting cows becomes available.

SUMMARY

1. The blood of the newly born calf contains no globulin or immune bodies. Colostrum is very rich in globulin and immune bodies. The globulin and immune bodies in colostrum pass into the blood of the newly born calf unchanged in the alimentary canal. These facts, and the further facts that disease and death rate is much higher among animals which do not receive colostrum than it is among those which do receive colostrum indicates that it is essential for newly born calves to get colostrum.

2. If the colostrum is infected with pathogenic organisms, these organisms may be inactivated by pasteurization. Pasteurization does not change the properties of colostrum to any appreciable extent provided the pasteurization is done in a water bath thereby avoiding local hot zones. On account of the relatively rapid rise of the temperature coefficient of heat-coagulation of proteins with rise of temperature, the lower pasteurization temperatures offer a wider margin of safety than the higher pasteurization temperatures; 140°F, is the safest temperature for pasteurizing colostrum.

3. Pasteurizing colostrum at 140°F. for twenty to thirty minutes does not appreciably change the properties of colostrum and experience shows that calves fed on such pasteurized colostrum get along in every respect as well as calves that are naturally fed, and very much better than calves which received no colostrum.

5. The satisfactory method to raise a calf from a cow infected with tuberculosis is therefore to separate the calf from its mother at birth, and feed the calf its mother's pasteurized colostrum during the first two to three days after birth. The colostrum should be pasteurized in a water bath at 145°F. for twenty minutes, or preferably at 140°F. for thirty minutes.

REFERENCES

BEATTIE, J. M., AND LEWIS, F. C. 1913–1914. The utilization of electricity in the continuous sterilization of milk. Jour. Path. and Bact., xviii, 120.

BUCKLEY, M. E. 1920 Bang system for reacting cattle at Lincoln Agricultural School. Proc. Eighty-eighth annual meeting New York State Agricultural Society. Bul. 128 of Department of Farms and Markets of the State of New York, Albany.

CHICK, H., AND MARTIN, C. J. 1910 The heat coagulation of proteins. Jour. Physiol., xl, 604; 1911, xliii, 1; 1912, xlv, 61 and 261.

CROWTHER, C., AND RAISTRICK, H. 1916 A comparative study of the proteins of the colostrum, and milk of the cow and their relation to serum proteins. Biochem Jour., x, 43.

FAMULENER, L. W. 1912 On the transmission of immunity from mother to offspring. A study upon serum hemolysins in goats. Journ. Infect. Diseases, x, 341.

GEWIN, J. Zur Frage des Ambozeptorgehaltes des Säuglingsblutes. Zeit. f. Immunitätf. und Exper. Therap., 1908–9, i, 613.

HOWE, P. E. 1921 An effect of the ingestion of colostrum upon the composition of the blood of new born calves. Jr. Biol. Chem., 1921, xlix, 115.

LANE-CLAYPON, J. E. 1916 Milk and its Hygienic Relations. London.

LEDINGHAM, J. C. G. 1907 On the relation of the antitoxin to the globulin-content of the blood serum during diphtheria immunization. Jour. Hyg., vii, 65.

LITTLE, R. B., AND ORCUTT, M. L. 1922 The transmission of agglutinins of bacillus abortus from cow to calf in the colostrum. Jour. Exp. Medicine, xxxv, 161.

OSSININ, T. A. 1913 Zur Frage über den Einfluss von Künstlicher Ernährung auf biologische Eigenschaften des organismus in dessen frühem Alter. Arch. f. Kinderh., lix, 98.

PAULI, W. 1903 Münchener Medizinische Wochenschrift. 153.

SCHMIDT, E. S. AND SCHMIDT, C. L. A. 1917 On the non-influence of injections of pure proteins upon the proportions of globulin and albulin in the blood serum. Jour. Immunology, ii, 343.

STAUBLI, 1906 München. Med. Wochenschrift, 798. Cited after Lane Claypon, loc. cit.

TRAUM, J. 1921 Raising calves without raw milk or colostrum. Jour. Amer. Veterinary Med. Assoc. n. s., xii, 756.

WELLS, H. G., AND OSBORNE, T. B. 1921 Anaphylaxis reactions with purified proteins from milk. Jour. Infect. Diseases, xxix, 200.

A STUDY OF DETERMINING SOLIDS-NOT-FAT IN COW'S MILK

BENJAMIN MASUROVSKY

Dairy Husbandry Department, University of Nebraska Lincoln, Nebraska[1]

Received for publication November 23, 1922

With the advancement of dairy manufacturing more and more attention is paid to close approximations and efficient methods of analyzing the raw material—milk. In butter making the butterfat test of the raw material is of primary importance. In the manufacturing of cheese, ice-cream, condensed and powdered milks, the estimation of milk-solids-not-fat is also desirable and sought by the cheese and ice-cream manufacturers. The determination of butterfat is satisfactorily accomplished by the well accepted Babcock test as approved by the American Dairy Science Association (1).

In the estimation of solids-not-fat, however, no special direct standard method is employed but its calculations are made indirectly. 1. The total solids of a given sample are found by using the gravimetric method II (2).

2. The percentage of butterfat is subtracted from the percentage of total solids and the difference indicates the percentage of S. N. F. (solids-not-fat). Or, various formulas are employed which enable one to estimate the total solids and solids-not-fat to a great degree of accuracy for all practical purposes. Among the well known formulas the following may be mentioned: Fleischmann's (3), Richmond's (4), Hehner and Richmond's (5), Ambuhl's (6) and Babcock's (7).

PURPOSE

The main purpose of this study is to find a formula which could be considered as a standard and deduct a workable coefficient

[1] Published by permission of the Director.

which will facilitate close approximations when using this formula as compared with gravimetric determinations. To accomplish this end the writer made use of the data compiled by R. H. Shaw

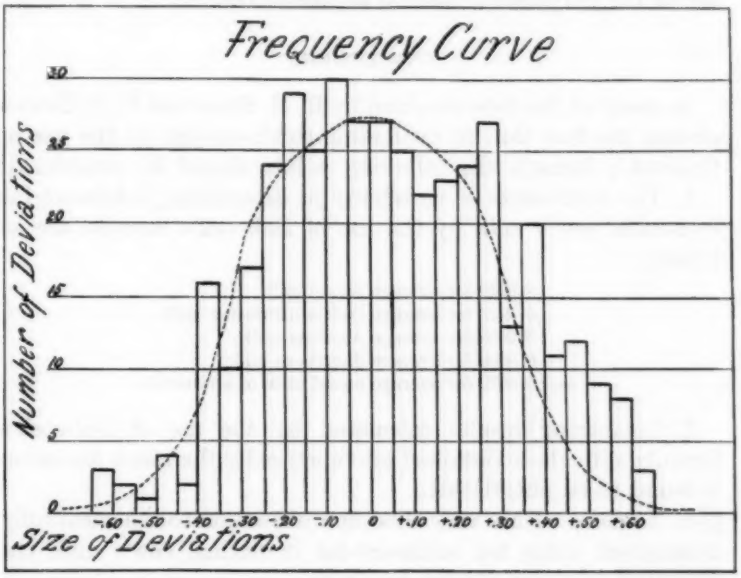
TABLE 1

Average specific gravity, nitrogen, sugar, fat and solids not fat for each cow, each breed and the total average

NUMBER OF COW	BREED	NUMBER OF CASES	SP. GR. QUEVENNE DEGREES	TOTAL N.	SUGAR LACTOSE	B. FAT	S. N. F. GRAVIMETRIC METHOD	S. N. F. BABCOCK METHOD	G/B COEFFICIENT
				per cent	*per cent*	*per cent*	*per cent*	*per cent*	
4	J.	25	33.4	0.61	4.79	4.88	9.31	9.33	0.9978.
99	J.	37	32.9	0.53	4.99	4.70	8.95	9.17	0.9760.
118	J.	33	34.2	0.65	4.87	5.39	9.66	9.63	1.003
Average for Jerseys..			33.5	0.60	4.88	4.99	9.31	9.38	0.9925.
205	H.	47	32.9	0.47	5.09	3.23	8.76	8.87	0.9875
206	H.	40	29.8	0.44	4.25	2.96	7.98	8.04	0.9925
209	H.	46	31.4	0.52	4.29	3.09	8.42	8.45	0.9964
Average for Holsteins.....			31.4	0.48	4.54	3.09	8.39	8.46	0.9917
300	A.	26	33.3	0.60	4.86	4.20	9.23	9.18	1.0054
300	A.	24	31.8	0.48	4.84	3.49	8.56	8.62	0.9918
301	A.	25	33.1	0.54	5.02	4.28	9.11	9.13	0.9978
301	A.	37	32.6	0.51	5.00	3.84	8.88	8.93	0.9944
302	A.	12	31.7	0.55	4.78	4.47	8.77	8.85	0.9909
Average for Ayrshires.....			32.5	0.54	4.90	4.05	8.90	8.94	0.9955
400	MS	35	33.9	0.53	5.09	3.86	9.22	9.26	0.9956
402	MS	29	33.8	0.54	4.97	4.04	9.16	9.24	0.9913
403	MS	14	33.2	0.49	5.23	3.34	8.78	8.97	0.9788
Average for milking Shorthorns.....			33.6	0.52	5.10	3.75	9.05	9.15	0.9890
Total average.....			32.8	0.54	4.86	3.97	8.92	8.99	0.9922

and C. H. Eckles (8). In their works a comparison of 430 determinations for T. S. in cow's milk, both gravimetrically and by the use of several formulas were cited and Babcock's formula proved to be the most efficient one. This conclusion based

upon exhaustive numbers of samples makes it possible to consider Babcock's formula for the determination of solids-not-fat in cow's milk (9), as a standard. Furthermore, a comparison of 430 determinations of solids-not-fat in cow's milk, both by the analytical chemical method and according to Babcock's formula is a reliable basis for calculating the coefficient of variability which is to be used in determining solids-not-fat of normal milks in connection with the application of Babcock's formula,



S N. F. equals $\frac{L}{4}$ plus0.2 f (L = Lactometer reading in Quevenne degrees, and f equals percentage of butterfat).

Table 1 shows that the average for the Jersey milk has been computed from 95 determinations, for Holstein-Friesian milk from 133 determinations, for Ayrshire milk from 124 determinations, and for Milking Shorthorns the averages are based on 78 determinations. The total average is the mean of the breed averages obtained through a total of 430 determinations. The G/B coefficient is the quotient of the percentage of solids-

not-fat obtained by the gravimetric method and the percentage of solids-not-fat for the same samples computed according to Babcock's formula.

The diagram presented here exhibits the close approximation of the deviations when compared with the hypothetical curve based upon the law of probabilities (10). The mean deviation of the determinations made by the application of Babcock's formula from the corresponding determinations derived by the use of the gravimetric method is plus 0.0604.

CONCLUSIONS

A study of the data obtained by R. H. Shaw and C. H. Eckles reveals the fact that in estimating solids-not-fat by the use of Babcock's formula the following points should be considered:

1. The coefficients of variability in determining solids-not-fat in normal cow's milk by the use of Babcock's formula are as follows:

0.9925 for average Jersey milk;
0.9917 for average Holstein Friesian milk;
0.9955 for average Ayrshire milk;
0.9890 for average Shorthorn milk;
and 0.9922 for average mixed milk of all breeds.

2. Comparing results calculated by the use of Babcock's formula with those obtained gravimetrically the mean deviation is found to be plus 0.0604.

3. To come within very close approximation to the chemically determined value for solids-not-fat in normal cow's milk the following formulas should be used:

(a) S. N. F. equal ($\frac{1}{4}$ plus 0.2 f.) $\times$ 0.9922.
or (b) S. N. F. equal ($\frac{1}{4}$ plus 0.2 f.) $-$ 0.0604.

I am greatly indebted to the United States Department of Agriculture, Bureau of Animal Industry for the available data contained in Bulletin 134.

REFERENCES

(1) Journal of Dairy Science, v, no. 2, p. 178.
(2) U. S. Dept. of Agr. Division of Chemistry, Bul. 107 (revised), p. 117.
(3) Journal für Landwirtschaft, Berlin, 1885, Band 33, p. 251.
(4) Richmond, H. D.: Dairy chemistry (1914), London, pp. 68–69.
(5) Leach, A. E.: Food inspection and analysis (1913), p. 151.
(6) Milchwirtschaftl Zentralbl(1921), pp. 2-3.
(7) Eighth Annual Report of Wisconsin Agric. Exp. Station (1891), p. 292.
(8) U. S. Dept. of Agriculture, Bureau of Animal Industry, Bulletin 134.
(9) Twelfth Annual Report of Wisconsin Agric. Exp. Station (1895), p. 120.
(10) King, W. J.: Elements of statistical methods New York, 1913.

NOTEWORTHY EVENTS IN THE WORLD'S DAIRY INDUSTRY 1922

T. R. PIRTLE

Division of Dairy and Poultry Products. Bureau of Agricultural Economics, United States Department of Agriculture

Received for publication January 20, 1923

The beginning of 1922 found the United Kingdom the greatest dairy market in the world with a surplus quantity of products on hand which had been purchased by the government. These supplies were disposed of early in the year and the effect of government control was removed and the natural law of supply and demand again became a factor in the trend of production, prices and distribution of the world's dairy products.

During the first ten months of the year, the United Kingdom continued to import increased quantities of butter, but for the first time since the war began, imports of cheese decreased. This indicated an increased demand for butter and a slackened demand for cheese in the world market.

CHANGES IN THE SOUTHERN HEMISPHERE

The industry of Argentina closed a very bad year last May, having suffered from drought and loss of cattle which reduced the exports of dairy products about one-third.

The Government of Australia, feeling the necessity of improving the quality of her exported dairy products, issued regulations prohibiting exports of butter and cheese unless it had been graded and branded by regularly appointed officials of the commonwealth. Five grades of butter were established, as follows:

1. Choice
2. First grade
3. Second grade
4. Third grade
5. Pastry

One outstanding change in the New Zealand dairy industry noted during the year was the lengthening of its production season. Usually the season has opened in October and closed in May, but it is being lengthened to reach even to July or later. This lengthening of the season has considerable effect upon world trade conditions at the beginning of the production season in the Northern Hemisphere.

The improved quality of product and important position of New Zealand in the English market is noteworthy. New Zealand butter is now generally quoted as high as the Danish, and the New Zealand cheese outranked the Canadian to such an extent that the Canadian cheese could not get proper consideration on the London market until the New Zealand cheese stocks had practically disappeared.

Another important factor in the New Zealand dairy industry is the type of their factories. Their factories are equipped to make butter or cheese as desired. If the market becomes loaded with one product they can turn immediately to the other product and thus supply the most favorable market. The smallness of the country and the existence of coöperative organizations make possible concerted action for the whole country. A bill was recently introduced in the legislature in New Zealand to control dairy exports and place the matter of contracts under a special committee. While this bill has not been reported as passed it shows the trend of sentiment on the marketing problem in that country.

TRENDS IN THE NORTHERN HEMISPHERE

During 1922 Denmark has sought to become less dependent upon butter as a principal dairy export product. Accordingly without neglecting its butter trade it has built up a cheese trade, since the war, principally with Germany, with grades and government inspection. It has also put condensed milk on its list of export products.

Conditions prevailing in the Netherlands during 1921 continued into 1922. Butter and cheese production were low on account of inability to meet the competition from New Zealand,

Australia, Argentina and Denmark in foreign markets. The milk was turned largely into condensed milk and by-products. In the first nine months of 1922 the Netherlands imported 9,013,476 pounds of butter from these countries, principally Australia and New Zealand. It is claimed that this unusual condition was due to the difference in exchange between the Netherlands and the countries usually buying her dairy products.

France removed the import tariff on butter in April and since that time has received an increasing import of unsalted butter, largely from Australia, New Zealand and Argentina, with a small amount from Denmark.

A notable event in Canada was the passing of an amendment to the Dairymen's Act of Alberta. This bill did away with cream buying stations and provided for Government inspection. The purpose of this Act was to raise the quality of butter made, by preventing the use of old, stale cream. In 1917 more than 50 per cent of the butter graded in Alberta was passed as special grade. By 1920 this quality had decreased until there was only 7.7 per cent of the special grade. The butter makers and the factories no doubt were as nearly perfect in efficiency in 1920 as they were in 1917 and the decrease in quality was due to the poor condition of the cream received.

In the United States one of the most significant factors in dairying was the large increase in consumption of butter and whole milk reported last year and a further increased consumption this year. The manufacture of sweet cream butter has also increased very rapidly during the year. This is rather a new departure in butter manufacture, for heretofore the demand has been chiefly for a product showing a mild to high lactic acid flavor and aroma. As sweet cream butter production increases, its merits will become better known. Sweet cream butter is now made in many creameries that formerly produced butter from sour cream. It is recognized as having a creamier flavor and better keeping quality.

SUMMARY OF 1922 TRENDS

Canada, New Zealand, Denmark, Australia and the United States have stressed the importance of quality, especially in butter. New Zealand butter ranks today on the English market with the best Danish. The greatest cheese exporting country now is New Zeland. Denmark holds her position on the butter market by the excellency of her butter and has endeavored to produce more cheese and condensed milk for export. It has also inaugurated an inspection service for export cheese which will guarantee its quality. The dairy industry of the Netherlands would have suffered greatly, or at least temporarily in 1922, but for the fact that her factories could make other kinds of dairy products besides butter.

The significance of these efforts toward excellency of quality of butter is not without a reason. The public is becoming more and more exacting in its demand for good butter. Development of sweet cream buttermaking in the United States is designed to meet this demand which is growing rapidly.

The advantage of having factories equipped so that they can make any kind of dairy products and can change from one product to another is great. Especially is this true in small countries where the industry is thoroughly organized and is largely dependent upon export markets.

In a word, the principal events of the year indicate progress in three lines: Better quality of products; closer grading and inspection; more complete organization making possible adjustment of production to market demands. Whenever any of the principal dairy countries develops a more complete factory organization for manufacture of dairy products, classifies and grades its products more closely and utilizes to a greater extent its geographical, seasonal, climatic, or other natural condition, in the development of its industry it immediately becomes incumbent on all other dairy countries to follow with equal progress if they would maintain their position in the world's dairy markets.

REVIEW OF FOREIGN DAIRY LITERATURE

R. C. FISHER

Storrs, Connecticut

VAN DAM W. AND SIRKS, H. A., Proef Zuivel Boerdery to Hoorn-Netherlands. Studies in Regard to Body and Consistency of Butter in the Netherlands.

1. The object of our investigations was to ascertain the varying degree in which creamfats from the different provinces of the Netherlands at different seasons of the year are subject to crystallization, this varying liability to crystallization being one of the most important factors determining the body of butter made from the cream. The degree of the tendency to crystallize was determined and numerically expressed by the application of the dilatometric method described in an earlier paper.[1] The amount of the expansion of 45 per cent creams on heating from 13° to 28°C. after cooling to 12°C. for twenty-one hours, was taken as a measure of the firmness to be expected in the butters made from them by faultless methods of manufacturing.

2. Every two weeks we examined the creams from twenty dairies, selected in such a way as to cause the influence of different circumstances in the production, as food, treatment, soil, etc., to come out as clearly as possible. We selected 4 dairies in Friesland, 2 dairies in North Holland, 2 dairies in Drente, 3 dairies in Gelderland, 2 dairies in Overijsel, 4 dairies in Brabant and 3 dairies in Limburg. The experiments were made in the summer of 1918 and in the stall-feeding season 1919–1920.

Besides the numbers given above for the expansion of the cream we determined those for iodine, the volatile acids (R.M.) and the refraction at 40°C. of the butterfat.

3. The figures obtained were noted down in the tables 1 to 20 (Annual Report for the year 1921) and graphically represented in curves. The following table and graph shows the combined average from all the dairies from which samples were obtained in the different parts of the Netherlands:

[1] cf. Verslagen van Landbouwkundige Onderzoekingen der Rijkslandbouwproefstations 16.1 (1915).

Table showing the average fat constants of butterfat in cream from 20 dairies in the Netherlands during different seasons of the year

	EXPANSION	IODINE NUMBER	REFRACTION NUMBER	R. M. NUMBER
April 29	146.4	40.2	44.2	30.8
May 13	137.0	41.9	44.6	30.5
May 27	143.7	40.8	44.3	30.6
June 10	149.6	39.4	43.9	30.3
June 24	154.1	40.0	44.1	29.8
July 8	150.8	40.8	44.3	29.6
July 22	145.0	42.9	44.9	28.7
August 5	142.1	43.9	45.0	28.4
August 19	140.0	43.4	45.2	27.9
September 2	138.4	43.7	45.3	27.6
September 16	139.1	43.8	45.4	26.9
September 30	138.7	43.8	45.2	26.9
October 14	143.4	42.6	44.9	26.7
October 28	157.1	39.3	44.2	27.4
November 11	170.9	36.3	43.3	28.4
November 24	182.0	33.5	42.8	28.8
December 8	179.3	33.9	42.9	28.8
December 19	174.9	34.8	42.8	29.2
January 5	172.2	34.8	42.9	29.0
January 19	170.9	34.9	43.1	29.6
February 2	170.3	34.6	43.1	29.0
February 16	167.3	34.9	43.3	30.3
March 1	166.5	35.7	43.3	31.0
March 15	167.9	34.7	43.2	31.2
March 29	166.1	35.3	43.3	31.3
April 12	161.2	37.2	43.5	30.8

Those obtained for the expansion are on the whole in harmony with what has been found to be the case in practice, weak-bodied butter being produced in the summer months and butter with a firm body in the winter, also when the influence of temperature is excluded. In the pasturing season small numbers were found for the expansion, in the stall-feeding season the numbers were great and this was found to hold for all the dairies. Further, our experiments on this large scale confirmed what we found in our earlier research,[1] viz., that the numbers for the expansion are approximately correlated to those for the iodine, great expansion numbers answering on the whole to small iodine-numbers and vice versa. As for the R. M. numbers we found former results confirmed, the numbers for autumn being higher in the southern provinces than in the northern provinces. It should be observed that there was much less regularity with regard to these numbers in the case of each particular dairy than there was in the other constants.

4. On closely examining the curves we found the results of practical experience during the summer season confirmed by our figures. The

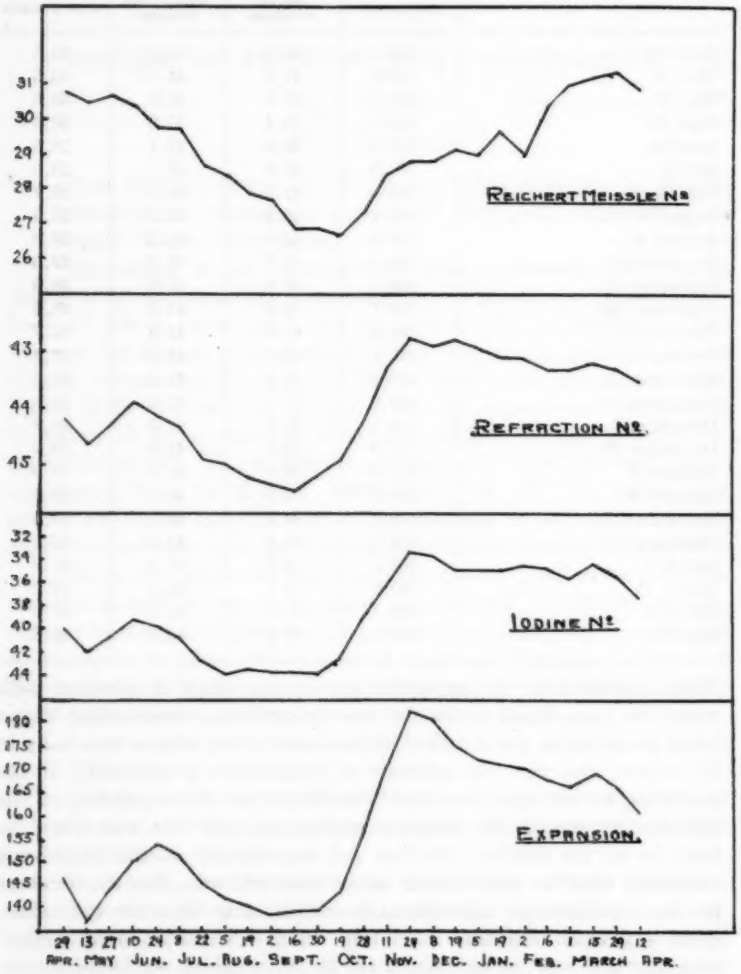


CHART 1. SHOWING THE AVERAGE FAT CONSTANTS OF BUTTERFAT IN CREAM FROM 20 DAIRIES IN THE NETHERLANDS DURING DIFFERENT SEASONS OF THE YEAR

production of a very weak-bodied butter during the first few weeks of pasturing, of more solid butter in June and July and of softer butter again in autumn was very correctly expressed by the expansion curves, as shown in the following table:

*Table showing amount of expansion of tendency to crystallize of 45 per cent cream during the pasturing or summer season**

PROVINCE IN WHICH CREAMERY IS LOCATED		AMOUNT OF EXPANSION								NUMBER OF SAMPLES	
		125–130	130–135	135–140	140–145	145–150	150–155	155–160	160–165	Below 140	Above 150
Noordbrabant	1.....	0	1	4	6	2	0	0	0	5	0
	2.....	0	0	0	4	3	3	1	1	0	5
	3.....	0	0	2	8	1	1	1	0	2	2
	4.....	0	0	1	2	5	3	1	1	1	5
Limburg	1.....	0	0	4	4	1	1	1	1	4	3
	2.....	00	0	3	4	2	2	1	0	3	3
	3.....	1	0	0	6	4	2	0	0	1	2
Gelderland	1.....	0	0	4	2	4	2	0	0	4	2
	2.....	0	2	3	2	4	0	0	0	5	0
	3.....	1	4	4	1	2	1	0	0	9	1
Overijssel	1.....	0	0	4	4	0	3	1	0	4	4
	2.....	0	4	3	2	2	1	0	0	7	1
Friesland	1.....	0	0	2	3	4	0	3	0	2	3
	2.....	0	0	5	2	1	3	1	0	5	4
	3.....	0	0	4	1	3	1	2	0	4	3
	4.....	0	0	0	2	5	2	3	0	0	5
Noordholland	1.....	0	4	2	3	0	3	0	0	6	3
	2.....	0	1	6	1	0	1	3	0	7	4
Drenthe	1.....	0	1	4	3	3	1	0	0	5	1
Total.....		2	17	55	60	46	30	18	3	74	51
		32 per cent Too low to make a sufficiently firm-bodied butter					22 per cent Such as to insure a good bodied butter				

* The amount of expansion of 45 per cent cream when heated from 13 to 38°C, after cooling to 12°C. for twenty-one hours was used as a means of measuring the firmness to be expected in the butter made from such cream.

The composition of 32 per cent of 231 samples examined in the summer season was found to be such as to exclude the possibility of producing a sufficiently firm-bodied butter from their fat. That of 22 per cent was such as to ensure the production of good butter. That of 46 per cent was found to be such as to render a good degree of hardness in the butter somewhat less likely than a not quite satisfactory one.

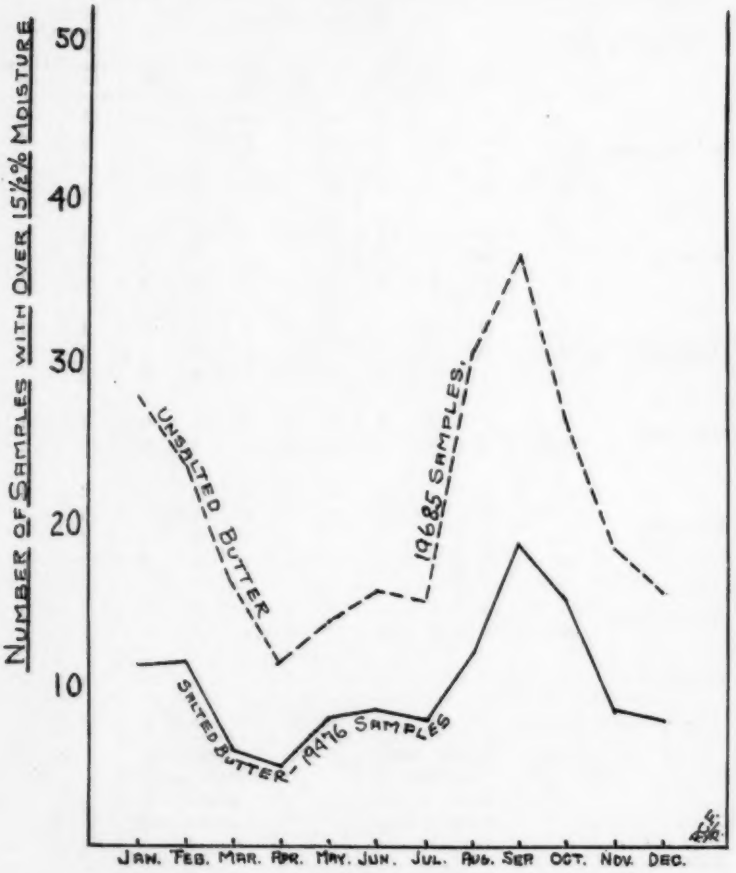


CHART 2. RELATION BETWEEN THE NUMBER OF SAMPLES OF BUTTER WITH MOISTURE CONTENT OVER 15.5 PER CENT AND THE SEASON OF THE YEAR

Analysis covers six year period in Netherlands

In those cases in which very distinct differences were observed in the expansion of creams got from different dairies in one and the same province, our numbers were found to tally almost exactly with the figures of the butter tests in that province.

5. We have also tried to account for the appearance of distinct maxima and minima in the curves of all the dairies in June and July and in autumn respectively with regard to the tendency to crystallize. The appearance of these maxima and minima tallies with practical experience as regards the body of the butter. Starting from the assumption that the composition of the butterfat is predominantly influenced by the qualities of the food eaten by the cattle we tried to establish how far these maxima and minima may be attributed to changes in the composition of the grass as consumed by the cattle in the summer.

*Table showing analysis of autumn meadow grass**

	CRUDE PROTEIN	DIGESTIBLE PURE PROTEIN	FIBRE	CARBO-HYDRATES
Mowed grass, October 21, 1915	18.0	10.7		
Mowed grass September 26, 1916	14.0	8.1	27.0	43.3
Mowed grass, October 12, 1917	17.2	9.6	25.0	38.2
Picked grass, September 9 to December 2, 1916	18.6	11.6	18.9	46.0
Mowed grass, November 1916	17.0		25.3	
Average for grass	17.0	10.0	24.0	42.5
Hay, 1906	10.6	4.0	35.2	43.1
Hay, 1909	11.9	4.8	33.4	40.6
Hay, 1909	12.4	6.8	34.0	40.8
Hay, 1909	9.0	4.1	36.7	43.2
Hay, 1916	11.3	5.5	33.7	42.6
Hay, 1920	16.4	7.1	32.6	39.2
Hay, 1920	9.5	5.2	31.5	47.2
Average for hay	11.6	5.5	33.9	42.4

* From unpublished analyses of the late Dr. Ott De Vries, Hoorn Experiment Station.

These analyses of autumn meadow-grass prove, that to the great difference of the composition of hay and of such grass the slightness of the crystallization in autmn may be due. The analyses show that in the months of September, October and November the cattle receive far too much nitrogenous matter and far too little cellulose. That the

butter becomes considerably less soft towards July is in accordance with our assumption, the bunches of grass eaten by the cattle being then in an advanced state of growth and there being less albumen and more cellulose in them than in new grass. We think that researches

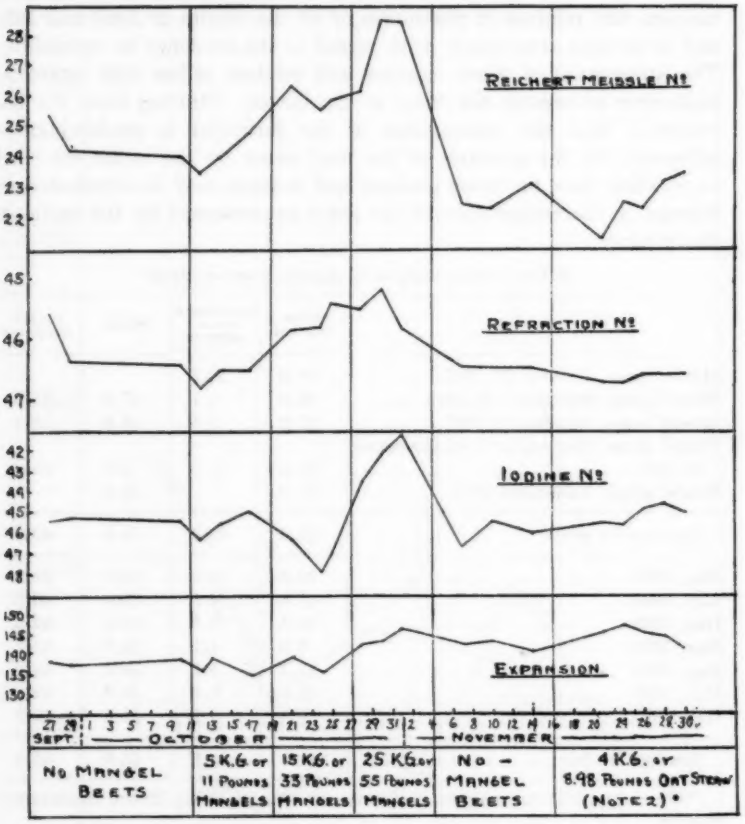


Chart 3. Showing Influence of Feeding Mangel Beets and Oat Straw on R. M. No., Refraction No., Iodine No. and Expansion No. of Butterfat

Cows on grass

* Pasture was changed on November 26, as there was more grass in this pasture, the straw was not relished as well and in some cases not eaten at all.

on an extensive scale concerning the composition of fresh grass as consumed by the cattle at different times in the pasturing season would be of the highest value with a view to the solution of this problem of the changes in the consistency of Dutch butter.

6. The above mentioned maxima of expansion in June and July which were observed in the creamfats of almost all the dairies, correspond in a remarkable degree with the numbers for the moisture content of the butter at this season, as determined by the butter control stations, Meyeringh[2] examined the moisture numbers of 19476 samples of salted butter and 19685 samples of unsalted butter and established the number of cases in the different months of the year in which the butter contained a high percentage of water, 15½ per cent or over. His figures refer to a course of six years.

In Meyeringh's curves our maximum for the expansion in the summer appears in the form of a marked decrease of the number of samples with a high moisture content, the correspondence with our results being very striking. This shows very clearly the correlation between the percentage of moisture in the butter and the composition of the cream fat.

7. Finally we have tried to improve the body of the butter in autumn by the addition of mangels to the food.

The favorable influence, though clearly observable in the expansion of the cream on adding 25 K. G. per cow, was by no means so strong as might have been expected from the changes in the iodine number and the refraction. It appeared that a number of 10 cows is too small for an experimenter to obtain reliable results in this kind of research.

A tentative experiment made under very unfavorable conditions brought out that the addition to the food of cellulose in the form of oatstraw may perhaps somewhat improve the autumn butter. We intend to make this experiment once more with a larger number of cows and under more favorable conditions.

[2] Diss. Delft 1911.

"Buflovak" Process

For Manufacturing

Powdered Milk Products

THE "Buflovak" Process of producing powdered milk is gradually replacing other methods because of certain inherent advantages which are lacking in most every other system. Some of these advantages are as follows:

Solubility—Dry milk solubility is often destroyed by overheating, which cannot occur in the "Buflovak" Process because of the high vacuum and consequent low temperature.

Flavor—The decidedly brief exposure of the milk to the heating surface preserves the natural flavor to a far greater extent than is possible where the milk is heated for long periods

Uniformity—Our patented devices (not obtainable in any other process) insures a uniform degree of dryness, which is not affected by changes in humidity or other atmospheric conditions.

High Yield—No solids can escape with the vapor. Consequently you receive the highest possible yield from each gallon of milk.

Cleanliness—The evaporating and drying equipment are so constructed that all parts of the interior are easily reached and can be thoroughly cleaned.

Low Cost of Production—The cost of production is surprisingly low—in fact much lower than with any other known system, and enables the manufacturer to produce dry milk at a good profit even when milk prices are at a low level.

"Buflovak" apparatus is sold outright under a substantial guarantee; consequently there are no royalties to be paid, a considerable saving in itself.

Send for the dry milk booklet.

Buffalo Foundry & Machine Co.

1581 Fillmore Ave., Buffalo, N. Y.

NEW YORK OFFICE: 17 BATTERY PLACE

Your advertisement is being read in every State and in 25 Foreign Countries

THE BESTOV CALENDAR

Complete Equipment to Handle Milk — from Cow to Consumer

Send for the new catalog of Bestov Tubular COOLERS—the finest coolers in the world.

See for yourself how these coolers are designed to give the utmost in cooler service. There are many details of superior construction not found in any other coolers, all fully described in this new booklet.

Bestov Coolers are made in every size and combination, including direct expansion sections.

Cherry-Bassett-Winner Company

PHILADELPHIA
BALTIMORE
PITTSBURGH
N. Y. City

Your advertisement is being read in every State and in 25 Foreign Countries

Progress

Every year by its lessons of careful breeding, balanced feeding and sanitary methods of handling, science is aiding the production of an improved quality and increased quantity of milk and milk foods.

And still another of its most significant contributions to better dairy processes is the sweet, wholesome, safe, sanitary cleanliness which the use of

Wyandotte
Dairyman's
Cleaner and Cleanser

so positively insures in thousands of creameries, dairies and cheese factories.

This dairy cleaner has such a natural cleaning action that it cleans quickly and with the least effort. It rinses so freely that the surface is left free of even the cleaner itself. It purifies and deodorizes and will leave all sour and stale places sweet and clean. And, furthermore, not only is it most economical to use, but it is also so harmless to metal and to the milk that it preserves your equipment, saving much of the expense of replacement and protects the high scoring quality of your product.

Indian in circle

in every package.

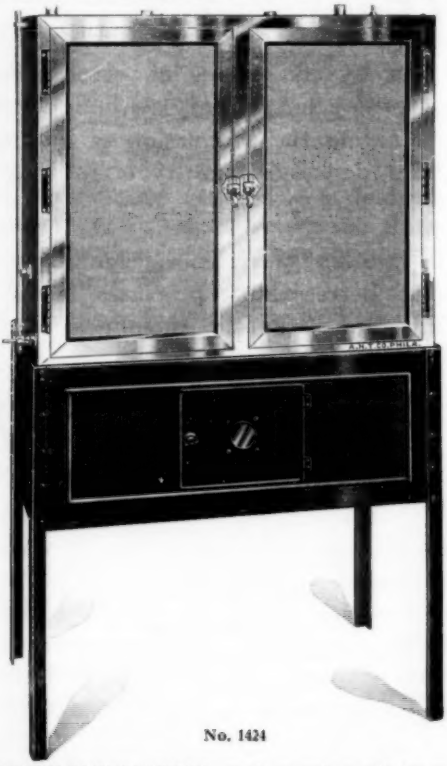
It cleans clean. Ask your supply man

The J. B. Ford Co., Sole Mnfrs., Wyandotte, Mich.

Your advertisement is being read in every State and in 25 Foreign Countries

AMERICAN STANDARD INCUBATORS

Superior, in our judgment, to any similar apparatus of European or American make in appearance, operation and durability



No. 1424

AMERICAN STANDARD INCUBATORS, continuously made for over thirty years in the same factory, in a triple wall construction providing both water and air jackets around the incubating chamber. This feature insures an even distribution of temperature not possible in any form of anhydric incubator with heating units at bottom of chamber. The internal construction of heavily tinned sheet copper and the external construction of polished copper with linoleum covering provide a durability not equalled in any other construction, some of these utensils having been in daily use in the same laboratory for over thirty years.

Furnished in six sizes, either without equipment, with gas heating equipment, or with the new electric equipment with a new form of bimetallic electric thermo-regulator of great sensitivity and simplicity of operation. Illustration shows largest size of series.

1424.	**American Standard Incubator,** inside dimensions 25 x 30 x 18 inches, without equipment	**$224.75**
1425.	ditto, with gas heating equipment	**265.00**
1426.	" " electric equipment for 110 volts	**275.75**

Above prices, which are considerably lower than those published in our catalogue, are subject to change without notice.

ARTHUR H. THOMAS COMPANY

WHOLESALE, RETAIL AND EXPORT MERCHANTS

LABORATORY APPARATUS AND REAGENTS

WEST WASHINGTON SQUARE **PHILADELPHIA, U. S. A.**

CABLE ADDRESS "BALANCE," PHILADELPHIA

Your advertisement is being read in every State and in 25 Foreign Countries

YEARS AGO

People here and there discovered that the fawn and white cow produces a high testing, deeply colored, richly flavored milk from a moderate amount of feed. Appreciation of this fact was crystallized in the public tests in 1893 and has been gaining momentum at a tremendous rate ever since. Let us send you booklets and other information about Guernseys.

THE AMERICAN GUERNSEY CATTLE CLUB

Box DS 43 **Petersboro, N. H.**

AUTHORITATIVE BOOKS

The Determination of Hydrogen Ions (Clark) 2nd ed.	$5.00
The Vitamine Manual (Eddy)	2.50
The Vitamines (Funk) 2nd ed.	5.50
The Heart Rhythms (Lamson)	2.50
Origin and Evolution of the Human Dentition (Gregory)	6.50
Psychology Classics: The Emotions (James-Lange)	3.50
Dictionary of Botanical Equivalents (Artschwager and Smiley)	2.00
Color Chart of Indicators (Clark)	1.00
Carriers in Infectious Diseases (Nichols)	3.50
The Bacteriophage—Its Rôle in Immunity (d'Hérelle). Amer. Ed.	4.00
Eugenics, Genetics and the Family	6.00
Eugenics in Race and State	6.00
Chemistry of Tuberculosis (Wells)	5.00
The Use of Job Analysis in Curriculum Construction (Strong and Uhrbrock)	2.00 cloth / 1.00 paper
Bacteriology (Conn)	4.00
Rest and Other Things (Krause)	1.50
Environment and Resistance in Tuberculosis (Krause)	1.50
Tubercle Bacillus Infection and Tuberculosis in Man and Animals (Calmette). Amer. Ed.	In Press
The Amino Acids (Holm and Gortner)	In Press
Manual of Determinative Bacteriology (Committee on Determinative Bacteriology of the Society of American Bacteriologists)	In Press

Canada, add 35 cents; other countries add 50 cents

WILLIAMS & WILKINS COMPANY

Publishers of Scientific Journals and Books

Baltimore, Maryland, U. S. A.

THREE NEW BOOKS

ENVIRONMENT AND RESISTANCE IN TUBERCULOSIS

By ALLEN K. KRAUSE, A.M., M.D.

A clear, original, satisfactory presentation of the nature of environment and resistance and their relation to the pathology, diagnosis, symptoms and treatment of tuberculosis. *"The last word on the subject."* Particularly recommended to physicians, tuberculosis workers and medical students.

Cloth, semi-flexible, *144* pages
$1.50 United States, Canada; $1.60 elsewhere

REST AND OTHER THINGS

By ALLEN K. KRAUSE, A.M., M.D.

A little book of plain talks on tuberculosis problems. For those who because of wide public health interest as clinicians or individual interest as laymen, seek for a better understanding of their patients, problems or of their own troubles, this book carries just the message that so many have sought to put into words.

Cloth, semi-flexible, *164* pages
$1.50 United States, Canada; $1.60 elsewhere

CHEMISTRY OF TUBERCULOSIS

By WELLS, DeWITT and LONG

A *thorough analysis* and a *critical review* of the recorded contributions on the chemistry of the tubercle bacillus and its products, the chemical changes and processes in the host, and the chemical aspects of the treatment of tuberculosis. Cloth, gold stamped, 435 pages. Numerous references. $5.00, United States; $5.25, Canada; $5.50, elsewhere.

WILLIAMS & WILKINS COMPANY

Publishers of Scientific Books and Journals

BALTIMORE, MARYLAND, U. S. A.

Enclosed is $_____, for which send me copies of the books checked above.

Name _____

Address _____

Your advertisement is being read in every State and in 25 Foreign Countries

DRAWINGS, ARTISTS' WORK AND ENGRAVINGS FOR MEDICAL AND SCIENTIFIC PUBLICATIONS

PUBLISHERS and authors working in the scientific field will be interested in our facilities for producing illustrations for such work. We have had years of experience in working in co-operation with some of the prominent authors and scientists of the Johns Hopkins University, which has developed in our organization an intimate knowledge of the requirements of this particular line of work. We offer you the services of the specialist in this line. Such are not available in every community, and as we are accustomed to working from written instructions, our clientele being largely at distant points, we subconsciously understand the illustrative point to emphasize, and have been very successful in satisfying our most critical patrons.

We will gladly make estimates, submit samples, and co-operate in every way possible in the production of such work.

BALTIMORE MARYLAND
ENGRAVING COMPANY

BALTIMORE, MARYLAND

Your advertisement is being read in every State and in 25 Foreign Countries

AN ANNOUNCEMENT

LACTA

Monthly review of the dairy industry, 15 Rue Beranger, Paris, France.

The most important French review, specializing in all interesting questions regarding the dairy industry.

This publication treats of the best processes of manufacture in French creameries, dairies, and factories.

Subscription price 26 francs a year.

SOIL SCIENCE

ESTABLISHED BY
RUTGERS COLLEGE

JACOB G. LIPMAN, Editor-in-Chief CARL R. WOODWARD, Assistant Editor

IN CONSULTATION WITH

DR. F. J. ALWAY	DR. H. J. CONN	DR. C. B. LIPMAN	PROF. G. ROSSI
DR. C. BARTHEL	DR. H. VON FEILITZEN	DR. F. LÖHNIS	DR. E. J. RUSSELL
DR. M. W. BEIJERINCK	DR. E. B. FRED	DR. T. L. LYON	DR. G. SCHREINER
PROF. A. W. BLAIR	DR. K. GREIG-SMITH	DR. E. A. MITSCHERLICH	DR. A. A. F. DE SIGMOND
DR. P. E. BROWN	DR. B. L. HARTWELL	PROF. C. A. MOOERS	PROF. CHAS. E. THORNE
DIRECTOR H. R. CHRISTENSEN		DR. THEO. REMY	DR. N. TULAIKOFF

Soil Science is devoted to the broader outlook of the entire field of soil fertility.

Articles dealing with the more important facts, observations, deductions and problems of soil biology, soil chemistry, and soil physics are published.

Papers devoted to plant physiology, agronomy, bacteriology, or geology, are accepted for publication if they contribute directly to the knowledge of soil fertility.

The study of the mineral and organic constituents of soils, soil gases, soil water as a solvent of soil material, soil colloids, the transformation of commercial plant foods in soils, questions that deal with the fundamental facts of soil fertility and productivity, are given due consideration.

The phenomena concerning soil micro-organisms, such as bacteria, molds, protozoa, and algae, receive careful attention.

SUBSCRIPTION ORDER FOR SOIL SCIENCE

Issued Monthly. Two Volumes (500 pages to a volume) a Year.

Current Volumes, Volumes XI and XII: $10.00, United States, Mexico, Cuba; $10.50, Canada; $11.00, other countries. Back Volumes, I to XI, inclusive: $50.00, United States, Mexico, Cuba; $52.50, Canada; $55.00, other countries. Prices are net, postpaid.

WILLIAMS & WILKINS COMPANY,
Mount Royal and Guilford Avenues,
Baltimore, Md., U. S. A

Please enter a subscription for Soil Science. Kindly begin subscription with the current volume, and forward numbers as issued. Remittance for $10 00 ($10.50, Canada; $11.00, other countries) is enclosed to cover two volumes.

Name.....

Address.....

Your advertisement is being read in every State and in 25 Foreign Countries

A Practical Manual on Carriers

Published September, 1922

CARRIERS IN INFECTIOUS DISEASES

A Manual on

The Importance, Pathology, Diagnosis and Treatment of Human Carriers

By

HENRY J. NICHOLS

Medical Corps, U. S. Army

Assistant Professor of Bacteriology, Parasitology and Preventive Medicine, Army Medical School, Washington, D. C.

With a chapter on

CARRIERS IN VETERINARY MEDICINE

By

R. A. KELSER

Veterinary Corps, U. S. Army

In Charge Veterinary Laboratory, Army Medical School, Washington, D. C.

A Manual prepared for medical students and physicians, especially those with public health responsibilities. An attempt is made to give a *systematic* discussion of carriers from the point of view of general medicine and surgery. The carrier state is treated as a drawn battle in the struggle of mankind with its parasites—as an individual victory, but a social defeat. On a pathological side, especial attention is paid to slight chronic inflammations of the tonsil and gall bladder. Clinical and laboratory diagnosis is fully discussed. In the treatment, excision of the focus is given first place. The last chapter deals with the place of carrier work in preventive medicine. The lessons of the War are incorporated.

ORDER FORM

Williams & Wilkins Company,
Mount Royal and Guilford Avenues,
Baltimore, Maryland, U. S. A.

Gentlemen: Kindly enter an order for _____copy (copies) of CARRIERS IN INFECTIOUS DISEASES by Henry J. Nichols. Remittance for $3.50, United States, Mexico and Cuba; ($3.75, Canada; $4.00, other countries) is enclosed to cover. (Or) Charge to me and send invoice to cover. (Terms, 30 days.)

Name_____

CID

Address _____

SENT ON TEN DAYS' APPROVAL TO RETAIL PURCHASERS IN UNITED STATES AND CANADA

Your advertisement is being read in every State and in 25 Foreign Countries

JOURNAL OF DAIRY SCIENCE

Official Organ

of

American Dairy Science Association

J. H FRANDSEN, *Editor-in-Chief*

THE JOURNAL OF DAIRY SCIENCE is devoted to the discussion of general and technical problems in the field of dairy science.

Original articles are published on dairy bacteriology, dairy chemistry, nutrition, butter making, market milk, cheese making, ice cream manufacture, condensed milk and milk powder, dairy cattle, breeding problems, dairy engineering, dairy management, dairy economics and such other problems as are of vital importance to the dairy industry.

As the most important technical and educational periodical in the dairy field, this authoritative journal is of vital interest to dairy instructors, investigators, inspectors, and manufacturers, as well as to students in all phases of dairy work.

Publishers of

Journal of Pharmacology and Experimental Therapeutics
Journal of Cancer Research
Journal of Immunology
Journal of Bacteriology
Abstracts of Bacteriology
Journal of Urology
Journal of Comparative Psychology

Published by

WILLIAMS & WILKINS COMPANY

Publishers of
Scientific Journals and Books

BALTIMORE MARYLAND, U. S. A.

Publishers of

Journal of Dairy Science
Soil Science
Botanical Abstracts
Genetics
Journal of Personnel Research
American Journal of Tropical Medicine
Archives of Occupational Therapy
Medicine
Annals of Clinical Medicine

Subscription order for

THE JOURNAL OF DAIRY SCIENCE

WILLIAMS & WILKINS COMPANY
PUBLISHERS OF SCIENTIFIC JOURNALS AND BOOKS
Mt. Royal and Guilford Avenues
BALTIMORE, MARYLAND, U. S. A.

Enter a subscription for THE JOURNAL OF DAIRY SCIENCE. Kindly begin subscription with the 1923 Volume, Volume VI, and forward numbers as issued. Remittance for $5.00, United States and dependencies, Mexico, Cuba ($5.25, Canada; $5.50, other countries) is enclosed.

Name .....

Address .....

Your advertisement is being read in every State and in 25 Foreign Countries

For Chemists, Physicists, Biologists, and Bacteriologists

SECOND EDITION

Revised and Enlarged

The Determination of Hydrogen Ions

by

W. Mansfield Clark, M.A., Ph.D.

Formerly Chemist, Research Laboratories of the Dairy Division, United States Department of Agriculture,
Professor of Chemistry, Hygienic Laboratory, United States Public Health Service

This treatise on the hydrogen electrode, indicator, and supplementary methods of determining hydrogen ion concentrations, with an indexed bibliography of two thousand references on applications, is an important contribution to the literature in this field.

Are You Interested in

analytical methods, in the acidity of your garden soil, in enzymes, in blood and the determination of acidosis, in modern methods of handling protein solutions, in the cultivation and study of bacteria, yeasts, molds and tissue, in autolysis, hydrogen ion catalyses, colloids, the digestive system, filtration, plant distribution, natural waters, the hydrogen ion concentration of biological fluids?

If so, you will need the methods and the references found in this treatise.

The second edition contains new material essential to those who wish to keep up to date in this interesting field.

2000 References

NUMEROUS ILLUSTRATIONS **INDICATOR CHART IN COLORS**

480 Pages

WILLIAMS & WILKINS COMPANY

Publishers of Scientific Journals and Books

BALTIMORE, U. S. A.

WILLIAMS AND WILKINS COMPANY,
Mount Royal and Guilford Avenues,
Baltimore, U. S. A.

Please enter an order for..... ..copy(ies) of the second edition of The Determination of Hydrogen Ions by W. Mansfield Clark, Ph.D. Remittance for $5.00, United States, Mexico, Cuba; $5.25, Canada; $5.50, other countries, is enclosed to cover, (or) Remittance will be made on receipt of your statement. (or) Remittance will be made about..... 1922.

Name .....
(Please state whether Dr., Prof., etc.)

Address.....

Your advertisement is being read in every State and in 25 Foreign Countries

A COMPLETE REFERENCE HANDBOOK

Published, January, 1923

ARE YOU INTERESTED IN TUBERCULOSIS?

If so, you will find essential information in

Chemistry of Tuberculosis

WELLS—DE WITT—LONG

A THOROUGH ANALYSIS and A CRITICAL REVIEW of the recorded contributions on the chemistry of the tubercle bacillus and its products, the chemical changes and processes in the host, and the chemical aspects of the treatment of tuberculosis

THIS MONOGRAPH owes its origin to the development of the systematic work on the chemotherapy of tuberculosis that has been carried on in the Otho S. A. Sprague Memorial Institute since its organization in 1911. This work at the Institute made it necessary to accumulate and review critically preceding and contemporaneous work on the chemical aspects of tuberculosis and related problems, a task by no means simple, since these data were so scattered in medical, chemical and bacteriological literature. The result of this labor has made available this monograph which is **PUBLISHED TO FACILITATE THE STUDY OF THE PROBLEMS OF TUBERCULOSIS AND TO SERVE AS A COMPLETE REFERENCE WORK** on the chemical processes of interest to the student of this disease.

THIS COMPLETE REFERENCE HANDBOOK will be of value to all persons interested in the study of tuberculosis or in the care of tuberculosis patients, since it will be possible to find in this book whatever has so far been learned concerning any chemical problem that may come up for consideration.

AN ADEQUATE MONOGRAPH

Cloth, gold stamped **438 pages, 6 x 9**

Numerous references to the literature

Order from your own bookseller or send your order to the Publishers

ORDER FORM

WILLIAMS & WILKINS COMPANY
MT. ROYAL AND GUILFORD AVENUES
BALTIMORE, MARYLAND, U. S. A.

Gentlemen: Kindly enter an order for one copy of **Chemistry of Tuberculosis,** by H. Gideon Wells, Lydia M. DeWitt, and Esmond R. Long. Remittance for $5.00, United States, Mexico, Cuba; $5.25, Canada; $5.50, other countries, is enclosed to cover. (Or) Charge to me and render invoice. (Terms, 30 days.) (Orders from countries other than the United States and Canada must be accompanied by cash which will be refunded promptly if the book is returned.)

Name .....
CTb

Address.....

SENT ON TEN DAYS' APPROVAL TO RETAIL PURCHASERS IN THE UNITED STATES AND CANADA

Your advertisement is being read in every State and in 25 Foreign Countries

INFORMATION FOR SUBSCRIBERS AND CONTRIBUTORS

THE JOURNAL OF DAIRY SCIENCE is issued bi-monthly, appearing in January, March, May, July, September and November. Each volume will consist of approximately 500 pages. Subscription is by the volume only and not by the year. One volume a year is issued at present.

Twenty-five reprints without covers of articles will be furnished gratis to contributors when ordered in advance. A table showing cost, with an order slip is sent with proof.

Manuscripts should be typewritten and carefully revised before submission and should be sent to Prof. J. H. Frandsen, 1401 N. 33d Street, Lincoln, Nebraska.

Correspondence concerning business matters should be addressed to WILLIAMS & WILKINS COMPANY, Publishers of Scientific Journals and Books, Mount Royal and Guilford Avenues, Baltimore, U. S. A.

1923 Volume: Volume VI, $5.00, United States, Mexico, Cuba; $5.25, Canada; $5.50, other countries. Prices are net, postpaid.

Back Volumes: Volumes I–V, incl., $30.00, United States, Mexico, Cuba, $31.25, Canada; $32.50, other countries. Prices are net, postpaid.

Subscriptions are received:

For Argentina and Uruguay: Beutelspacher y Cia., Sarmiento 815, Buenos Aires.

For Australia: Angus & Robertson, Limited, Sydney; Stirling & Co., 317 Collins St., Melbourne.

For the British Empire, except Australia and Canada: Arthur F. Bird; Wm. Dawson & Sons, Ltd.; Dulau & Co., Ltd.; H. K. Lewis & Co.; David Nutt; J. Poole & Co.; Wheldon & Wesley, Williams & Norgate, London; James Thin, Edinburgh.

For Canada: Wm. Dawson and Sons, Ltd., 87 Queen Street, East, Toronto Canada.

For Denmark: H. Hagerup's Boghandel, Gothersgade 30, Kobenhavn.

For France: Emile Bougault, 48 Rue des Ecoles, Paris.

For Germany: R. Friedländer & Sohn, Buchhandlung, Carlstrasse 11, Berlin NW. 6.

For Holland: Scheltema & Holkema, Rokin 74–76, Amsterdam.

For Japan and Korea: Maruzen Company, Ltd. (Maruzen-Kabushiki-Kaisha) 11 to 15 Nihonbashi Tori-Sanchome, Tokyo; Fukuoka, Osaka, Kyoto, and Sendai, Japan.

For Spain: Ruiz Hermanos, Plaza de Santa Ana, 13, Madrid.

For the United States and all other countries except as above: WILLIAMS & WILKINS COMPANY, Mount Royal and Guilford Avenues, Baltimore, U. S. A.

Claims for copies lost in the mails must be received within thirty days (domestic), ninety days (foreign) of the date of issue. Changes of address must be received at least two weeks in advance of issue.

De Laval Separator in the Klinger Creamery Company's plant, Fairbank, Iowa.

Better quality of De Laval-separated cream makes prize-winning butter

The supremacy of De Laval Separators is proved year after year at the annual convention of the National Buttermaker's Association. Butter made from De Laval-separated cream has won first prize at each annual meeting of this association with but one exception since its organization in 1892. As a rule the other prizes are also won by De Laval users.

At last year's convention users of De Laval Separators won first and second prizes in both the Fresh and Whole Milk Storage Butter classes. The illustration shows the Klinger Creamery Company's plant, at Fairbank, Iowa, where butter which took second prize in the Fresh Creamery class was made by H. Segebarth.

There is no getting away from the fact that you can't make a quality product without quality equipment.

You can't get sweet cream with a separator that cannot be properly cleaned. You can't get smooth cream with one that breaks the fat globules. You can't get heavy cream without loss of butter-fat with a machine that does not skim clean.

Those are a few reasons why De Lavals are used almost exclusively in creameries and milk plants throughout the world.

Write for the De Laval Factory-size Separator Catalogue, mentioning the amount of milk handled daily and the capacity of present machines.

The De Laval Separator Company

NEW YORK 165 Broadway | CHICAGO 29 East Madison Street | SAN FRANCISCO 61 Beale Street

Sooner or later you will use a

De Laval

Gentlemen: Please send catalogue giving information regarding the new De Laval Separator.

Name .....

Company .....

Address .....

.....

DIFCO

BACTO-COOLEDGE BROTH DEHYDRATED
FOR
"A RAPID AND ACCURATE ESTIMATION OF THE KEEPING QUALITY OF MILK"
(SEE BULLETIN 170)

BACTERIOLOGICAL REAGENTS "DIFCO-STANDARDIZED"
Recommended for use in the Bacteriological Analysis of Dairy Products

Bacto Peptone **Bacto Agar** **Bacto Dextrose**
Bacto Beef **Bacto Gelatin** **Bacto Lactose**
Beef Extract—Bacteriological

DEHYDRATED CULTURE MEDIA "DIFCO-STANDARDIZED"
The principal Formulas of the A. P. H. A. "Standard Methods"

Bacto Nutrient Agar **Bacto Nutrient Broth**
Bacto Lactose Broth

Specify "DIFCO"
THE TRADE NAME OF THE PIONEERS
In the research and production of Bacto-Peptone and Dehydrated Culture Media

DIGESTIVE FERMENTS COMPANY
DETROIT, MICHIGAN, U. S. A.

THE STANDARD FOR NEARLY FORTY YEARS

TRADE MARK

Paterson Vegetable Parchment

"Nearest to Perfection"

Nearly forty years ago we were making Vegetable Parchment.

One does not specialize for nearly forty years without coming very close to Perfection.

The Paterson Parchment Paper Co.

Passaic, New Jersey